JAGUAR

3·8 "E" TYPE
GRAND TOURING MODELS

SERVICE MANUAL

Jaguar Cars Limited reserve the right to make changes in design, or to make additions to or improvements upon their products without incurring any obligation to install the same on vehicles previously built.

ISSUED BY

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SECTION A

GENERAL INFORMATION

3·8 "E" TYPE
GRAND TOURING MODELS

Note: All references in this Manual to "right-hand side" and "left-hand side" are made assuming the person to be looking from the rear of the car or unit.

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GENERAL INFORMATION

CAR IDENTIFICATION

It is imperative that the Car and Engine numbers, together with any prefix or suffix letters, are quoted in any correspondence concerning this vehicle. If the unit in question is the Gearbox the Gearbox number and any prefix or suffix letters must also be quoted. This also applies when ordering spare parts.

Car Number .. ..

Stamped on the right-hand frame/cross member above hydraulic damper mounting.

Engine Number .. ..

Stamped on the right-hand side of the cylinder block above the oil filter and at the front of the cylinder head casting.

/8 or /9 following the engine number denotes the compression ratio.

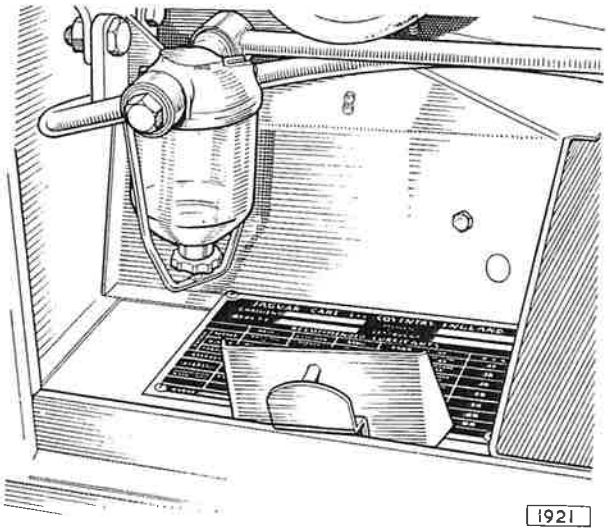

Fig. 1 The identification numbers are also stamped on a plate situated in the engine compartment

Gearbox Number .. ..

Stamped on a shoulder at the left-hand rear corner of the gearbox casing and on the top cover.

Body Number .. ..

Stamped on a plate attached to the right-hand side of the scuttle.

Key Numbers .. ..

The keys provided operate the ignition switch and door locks.

GENERAL DATA

DIMENSIONS AND WEIGHTS

Wheel base	8′ 0″ (2·44 m.)
Track, Front	4′ 2″ (1·27 m.)
Track, Rear	4′ 2″ (1·27 m.)
Overall length	14′ 7$\frac{5}{16}$″ (4·45 m.)
Overall width	5′ 5$\frac{1}{4}$″ (1·66 m.)
Overall height (Fixed head coupé)	4′ 0$\frac{1}{8}$″ (1·22 m.)
(Open 2-seater)	3′ 10$\frac{1}{2}$″ (1·18 m.)
Weight (dry) approximate (Fixed head coupé)	22$\frac{1}{2}$ cwts. (1123 kg.)
(Open 2-seater)	22 cwts. (1098 kg.)
Turning circle	37′ 0″ (11·27 m.)
Ground clearance	5$\frac{1}{2}$″ (140 mm.)

CAPACITIES

	Imperial	U.S.	Litres
Engine (refill)	15 pints	18 pints	8·5
Gearbox	2$\frac{1}{2}$ „	3 „	1·42
Rear axle	2$\frac{3}{4}$ „	3$\frac{1}{4}$ „	1·54
Cooling system (including heater)	32 „	38$\frac{1}{2}$ „	18·18
Petrol tank	14 galls.	16$\frac{3}{4}$ galls.	63·64

PERFORMANCE DATA

The following table gives the relationship between engine revolutions per minute and road speed in miles and kilometres per hour.

The safe maximum engine speed is 5,500 revolutions per minute.

Engines must not, under **Any Circumstances** be allowed to exceed this figure.

It is recommended that engine revolutions in excess of 5,000 per minute should not be exceeded for long periods. Therefore, if travelling at sustained high speed on motorways, the accelerator should be released occasionally to allow the car to overrun for a few seconds.

ROAD SPEED		ENGINE REVOLUTIONS PER MINUTE	ENGINE REVOLUTIONS PER MINUTE	ENGINE REVOLUTIONS PER MINUTE
Kilometres per hour	Miles per hour	Top Gear 3.31:1	Top Gear 3.07:1	Top Gear 3.54:1
16	10	436	405	466
32	20	873	810	932
48	30	1309	1215	1398
64	40	1745	1614	1862
80	50	2182	2008	2319
96	60	2618	2398	2775
112	70	3054	2780	3221
128	80	3490	3156	3667
144	90	*3800	3521	4110
160	100	*4200	3877	4542
176	110	*4600	4227	4963
192	120	*5000	4562	5416
208	130	*5410	4887	—
225	140	—	5200	—
240	150	—	5506	—

*The figures marked thus make allowance for changes in tyre radius due to the effect of centrifugal force.

OPERATING INSTRUCTIONS

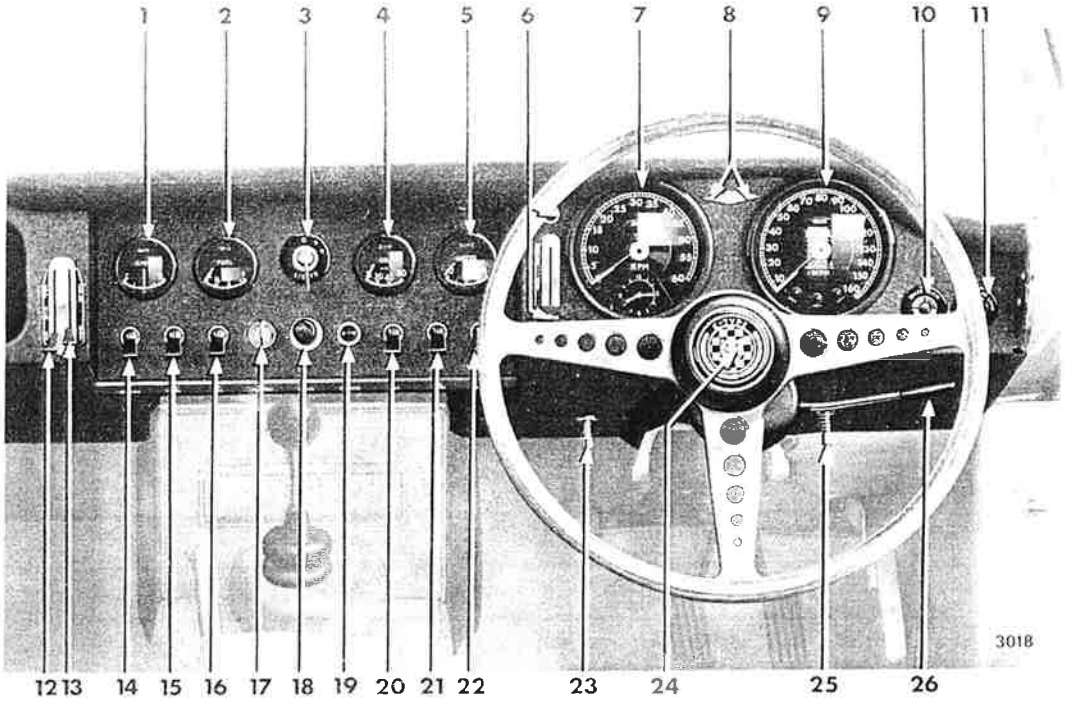

Fig. 2. Instruments and Controls—Right-hand drive

1. Ammeter.
2. Fuel contents gauge.
3. Lighting switch.
4. Oil pressure gauge.
5. Water temperature gauge.
6. Mixture control and warning light.
7. Revolution counter.
8. Flashing direction indicator warning lights.
9. Speedometer.
10. Brake fluid warning light.
11. Headlamp dipper switch.
12. Heater—Air Control.
13. Heater—Temperature control.
14. Interior light switch.
15. Panel light switch.
16. Heater fan switch.
17. Ignition switch.
18. Cigar lighter.
19. Starter switch.
20. Map light switch.
21. Windscreen wiper switch.
22. Windscreen washer switch.
23. Clock adjuster.
24. Horn button.
25. Speedometer trip control.
26. Flashing direction indicator and headlamp flashing switch.

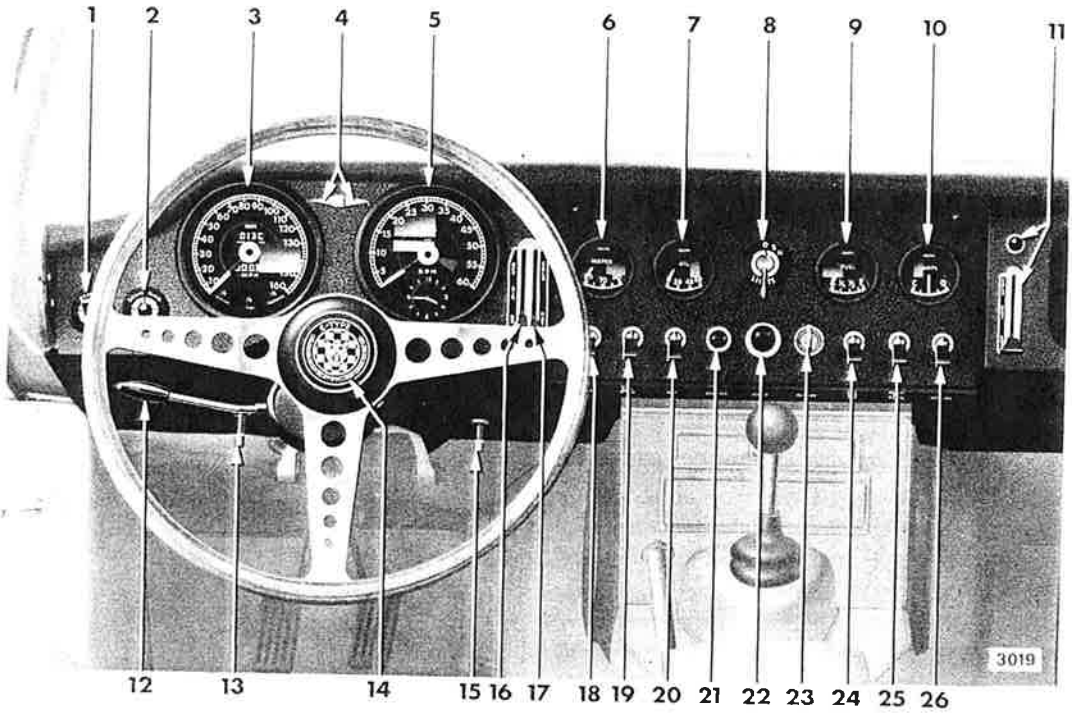

Fig. 3. Instruments and Controls—Left-hand drive

1. Headlamp dipper switch.
2. Brake fluid warning light.
3. Speedometer.
4. Flashing direction indicator warning lights.
5. Revolution counter.
6. Water temperature gauge.
7. Oil pressure gauge.
8. Lighting switch.
9. Fuel contents gauge.
10. Ammeter.
11. Mixture control and warning light.
12. Flashing direction indicator and headlamp flashing switch.
13. Speedometer trip control.
14. Horn button.
15. Clock adjuster.
16. Heater—air control.
17. Heater—temperature control.
18. Windscreen washer switch.
19. Windscreen wiper switch.
20. Map light switch.
21. Starter switch.
22. Cigar lighter.
23. Ignition switch.
24. Heater fan switch.
25 Panel light switch.
26. Interior light switch.

INSTRUMENTS

Ammeter

Records the flow of current into or out of the battery. Since compensated voltage control is incorporated, the flow of current is adjusted to the state of charge of the battery; thus when the battery is fully charged the dynamo provides only a small output and little charge is registered on the ammeter, whereas when the battery is low a continuous high charge is shown.

Oil Pressure Gauge

The electrically operated pressure gauge records the oil pressure being delivered by the oil pump to the engine; it does not record the quantity of oil in the sump. The minimum pressure at 3000 r.p.m. when hot should not be less than 40 lbs. per square inch.

Note: After switching on, a period of approximately 20 seconds will elapse before the correct reading is obtained.

Water Temperature Gauge

The electrically operated water temperature gauge records the temperature of the coolant by means of a bulb screwed into the inlet manifold water jacket.

Fuel Level Gauge

Records the quantity of fuel in the supply tank. Readings will only be obtained when the ignition is switched "on". An amber warning light situated in the speedometer lights up intermittently when the petrol level in the tank becomes low. When the petrol is almost exhausted the warning light operates continuously.

Note: After switching on, a period of approximately 20 seconds will elapse before the correct reading is obtained.

Electric Clock

The clock is built in the revolution counter instrument and is powered by the battery. The clock hands may be adjusted by pushing up the winder and rotating. Starting is accomplished in the same manner.

Revolution Counter

Records the speed of the engine in revolutions per minute.

Speedometer

Records the vehicle speed in miles per hour, total mileage and trip mileage (kilometres on certain export models). The trip figures can be set to zero by pushing the winder upwards and rotating clockwise.

Headlamp Warning Light

A red warning light marked "Headlamps" situated in the speedometer, lights up when the headlamps are in full beam position and is automatically extinguished when the lamps are in the dipped beam position.

Ignition Warning Light

A red warning light (marked "Ignition") situated in the speedometer lights up when the ignition is switched "on" and the engine is not running, or when the engine is running at a speed insufficient to charge the battery. The latter condition is not harmful, but always switch "off" when the engine is not running.

Fuel Level Warning Light

An amber warning light (marked "Fuel") situated in the speedometer lights up intermittently when the fuel level in the tank becomes low. When the fuel is almost exhausted the warning light operates continuously.

Flashing Indicator Warning Lights

The warning lights are in the form of green arrows located on the facia panel situated behind the steering wheel.

When the flasher indicators are in operation one of the arrows lights up on the side selected.

Mixture Control Warning Light

A red warning light situated above the mixture control on the facia panel behind the steering wheel serves to indicate if the mixture is in operation. This warning light is illuminated immediately control lever is moved from "off" position.

To change the bulb, accessible behind the facia panel, pull bulb holder away from "clip in" attachment, and unscrew bulb by turning anti-clockwise. For full instructions on the use of the mixture control see "Starting and Driving," page A16.

Brake Fluid Level and Handbrake Warning Light

A warning light (marked "Brake Fluid—Handbrake") situated on the facia behind the steering wheel, serves to indicate if the level in either of the two brake fluid reservoirs has become low, provided the ignition is "on". As the warning light is also illuminated when the handbrake is applied, the handbrake must be fully released before it is assumed that fluid level is low. If with the ignition "on" and the handbrake fully released the warning light is illuminated the brake fluid must be "topped up" and the reason for the loss investigated and corrected immediately. IT IS ESSENTIAL that the correct specification of brake fluid be used when topping up.

As the warning light is illuminated when the handbrake is applied and the ignition is "on" a two-fold purpose is served. Firstly, to avoid the possibility of driving away with the handbrake applied. Secondly, as a check that the warning light bulb has not "blown"; if on first starting up the car with the handbrake fully applied, the warning light does not become illuminated the bulb should be changed immediately.

CONTROLS AND ACCESSORIES

Accelerator Pedal

Controls the speed of the engine.

Brake Pedal

Operates the vacuum servo assisted disc brakes on all four wheels.

Clutch Pedal

Connects and disconnects the engine and the transmission. Never drive with the foot resting on the pedal and do not keep the pedal depressed for long periods in traffic. Never coast the car with a gear engaged and clutch depressed.

Headlamp Dipper

Situated on the facia panel behind the steering wheel. The switch is of the "flick-over" type, and if the headlamps are on main beam, moving the lever will switch the dipped beam on, and main beam off. They will remain so until the switch lever is reversed.

Gear Lever

Centrally situated and with the gear positions indicated on the control knob. To engage reverse gear first press the gear lever against the spring pressure before pushing the lever forward. Always engage neutral and release the clutch when the car is at rest.

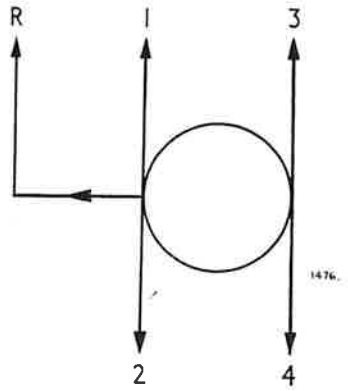

Fig. 4. The gear positions

Handbrake Lever

Positioned centrally between seats. The handbrake operates mechanically on the rear wheels only and is provided for parking, driving away on a hill and when at a standstill in traffic. To apply the brake, pull the lever upward and the trigger will automatically engage with the ratchet. The handbrake is released by pressing in the knob, and pushing the lever downward.

Seat Adjustment

Both front seats are adjustable for reach. Push the lock bar, situated beside the inside runner, towards the inside of the car and slide into the required position. Release the lock bar and slide until the mechanism engages with a click.

Steering Wheel Adjustment

Rotate the knurled ring at the base of the steering wheel hub in an anti-clockwise direction when the steering wheel may be slid into the desired position. Turn the knurled ring clockwise to lock the steering wheel.

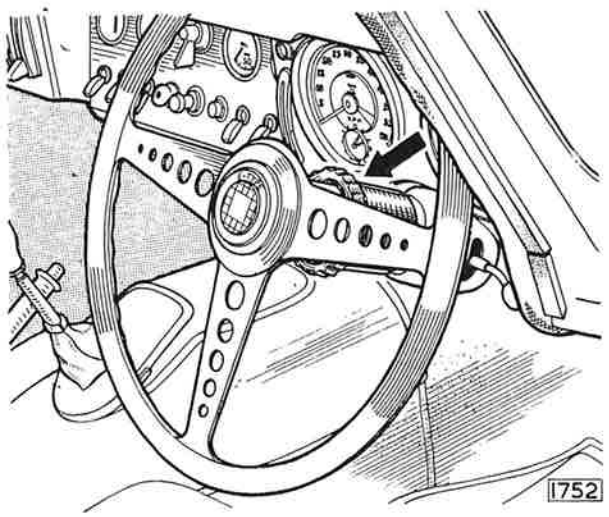

Fig. 5. Steering wheel adjustment

Door Locks

The doors may be opened from the outside by pressing the button incorporated in the door handle. The doors are opened from the inside by pulling the interior handles rearward.

Both doors can be locked from the inside by pushing the interior handles forward and allowing them to return to their original position; this feature only applies if the doors are fully closed before operating the interior handles. Both doors can be locked from the outside by means of the ignition key; the locks are incorporated in the push buttons of the door handles.

To lock the right-hand door insert the key in the lock, rotate anti-clockwise as far as possible and allow the lock to return to its original position—the door is now locked. To unlock the right-hand door turn key clockwise as far as possible and allow the lock to return to its original position.

To lock the left-hand door rotate key clockwise; to unlock, rotate key anti-clockwise.

KEYLESS LOCKING is obtainable by first pushing the interior door handle fully forward and allowing it to return to its original position. If the door is now closed from the outside with the push button of the handle **fully depressed** the door will become locked.

Warning.—If the doors are to be locked by this method the ignition key should be removed beforehand (or the spare key kept on the driver's person) as the only means of unlocking the doors is with this key.

Horn

Depress the circular button in the centre of the steering wheel to operate the horns.

Note.—The horns will not operate if ignition is off.

Ignition Switch

Inserting the key provided in the switch and turning clockwise will switch on the ignition.

Never leave the ignition on when the engine has stopped, a reminder of such circumstances is provided by the ignition warning light situated in the speedometer.

Interior Light Switch

Lift the switch lever (marked "Interior") to illuminate the car interior.

Lighting Switch

From "Off" can be rotated into two positions, giving in the first location side and tail, and in the second location head, side and tail.

Panel Light Switch

Lift the switch lever (marked "Panel") to enable the instruments to be read at night and to provide illumination of the switch markings. The switch has two positions "Dim" and "Bright" to suit the driver's requirements. The panel lights will only operate when the side lights are switched on.

Starter Switch

Press the button (marked "Starter") with the ignition switched on, to start the engine. Release the switch immediately the engine fires and never operate the starter when the engine is running.

Flashing Direction Indicator

The "flashers" are operated by a lever behind the steering wheel. To operate the flashing direction indicators on the right-hand side of the car, move the lever clockwise; to operate the left-hand side indicators, move the lever anti-clockwise. While the flashing indicators are in operation, one of the warning lights on the facia panel behind the steering wheel will flash on the side selected.

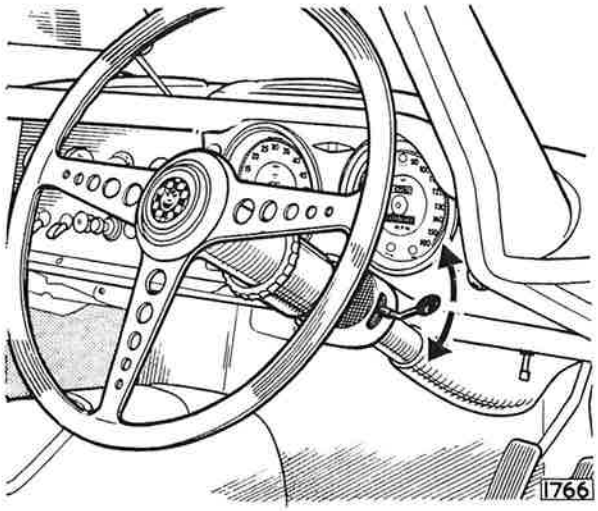

Fig. 6. The flashing direction indicator control

Map Light

Lift the switch lever (marked "Map") to illuminate the lamp situated above the instrument panel. To provide ease of entry into the car at night the map light is switched on when either one of the doors is opened, and is extinguished when the door is closed.

Headlamp Flasher

To "flash" the headlamps as a warning signal, lift and release the flashing indicator lever in quick succession. The headlamps can be "flashed" when the lights are "off" or when they are in the dipped beam position; they will not "flash" in the main beam position.

Braking Lights

Twin combined tail and brake lights are situated at the rear of the car. The latter automatically light up when the footbrake is applied.

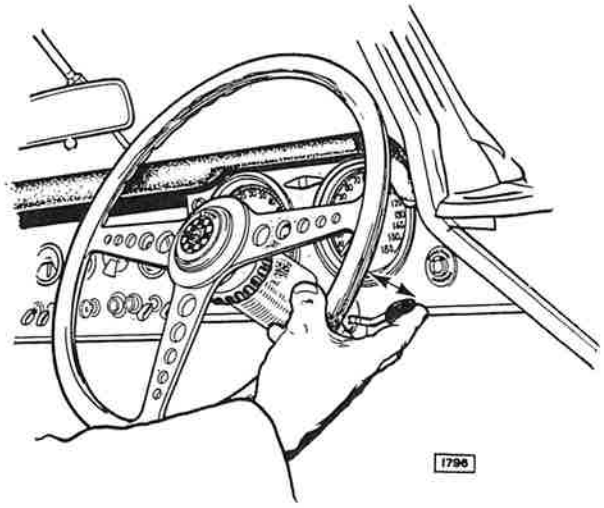

Fig. 7. Method of "flashing" the headlamps

Luggage Compartment Illumination

The luggage compartment is illuminated by the interior light when this lamp is switched on.

Cigar Lighter

To operate, press holder (marked "Cigar") into the socket and remove the hand. On reaching the required temperature, the holder will return to the extended position. Do not hold the lighter in the "pressed-in" position.

Windscreen Wipers

The wipers are controlled by a three position switch (marked "Wiper"). Lift the switch to the second position (Slow) which is recommended for all normal adverse weather conditions and snow.

For conditions of very heavy rain and for fast driving in rain lift the switch to the third position (Fast). This position should not be used in heavy snow or with a drying windscreen, that is, when the load on motor is in excess of normal; the motor incorporates a protective cut-out switch which under conditions of excessive load cuts off the current supply until normal conditions are restored.

When the switch is placed in the "Off" position the wipers will automatically return to a position along the lower edge of the screen.

Windscreen Washer

The windscreen washer is electrically operated and comprises a glass water container mounted in the engine compartment, which is connected to jets at the base of the windscreen. Water is delivered to the jets by an electrically driven pump incorporated in the water container.

Operation

The windscreen washer should be used in conjunction with the windscreen wipers to remove foreign matter that settles on the windscreen.

Lift the switch lever (marked "Washer") and release immediately, when the washer should operate at once and continue to function for approximately seven seconds. Allow a lapse of time before operating the switch a second time.

For full instructions on the use of the Windscreen Washing Equipment see Section "O".

Heating and Ventilating Equipment

The car heating and ventilating equipment consists of a heating element and an electrically driven fan mounted on the engine side of the bulkhead. Air from the heater unit is conducted:

(a) To a built in duct fitted with two doors situated behind the instrument panel.
(b) To vents at the bottom of the windscreen to provide demisting and defrosting.

The amount of fresh air can be controlled at the will of driver and is introduced into the system by operating the "Air" control lever and switching on the fan.

For full instruction on the use of the Heating and Ventilating Equipment see Section "O".

Steering Column—Adjustment for Rake

The steering column can be adjusted for rake. To adjust, release nut and bolt at the top of the column located behind the instrument panel, and adjust to suit requirements. Re-tighten nut fully after adjustment.

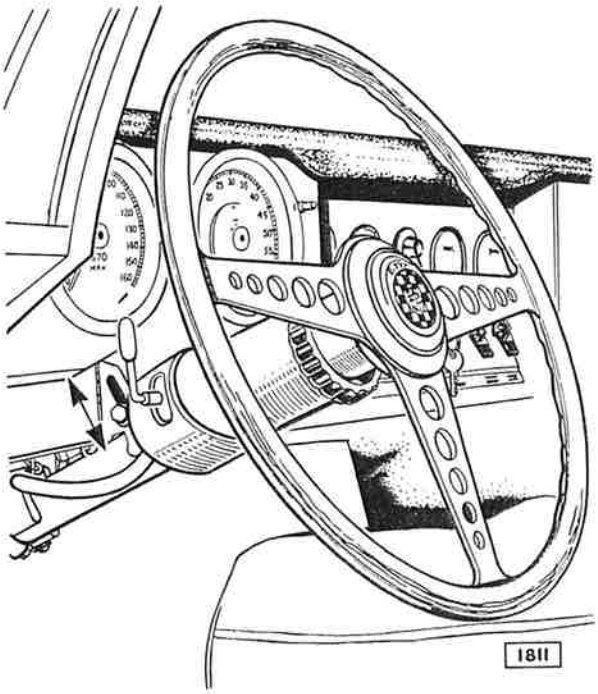

Fig. 8. Steering column adjustment for rake

Bonnet Lock (Early Cars)

The bonnet is locked by means of the two locks situated at the sides of the bonnet.

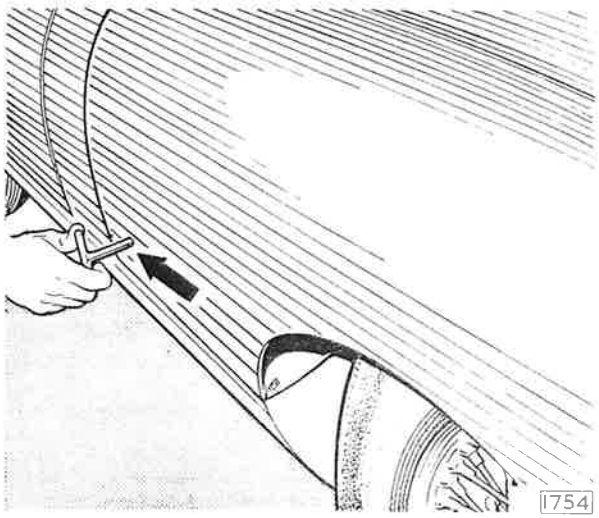

Fig. 9. Unlocking the bonnet (early cars)

To open the bonnet insert the "T" handle key provided in the lock and on the right-hand side turn key clockwise, and on the left-hand side turn key anti-clockwise.

This will release the bonnet which will now be retained by the safety catch. Insert the fingers under the rear edge of the bonnet and press in the safety catch.

To close the bonnet push down to the safety catch position. Hold the bonnet depressed and insert the "T" handle in the lock. On the right-hand side turn the key anti-clockwise and on the left-hand side turn the key clockwise.

(Later Cars)

The bonnet is locked by means of two locks situated at the sides of the bonnet. To open the bonnet, turn the two small levers located on the right and left-hand door hinge posts anti-clockwise and pull to full extent.

This will release the bonnet, which will now be retained by the safety catch.

Insert the fingers under the rear edge of the bonnet and press in the safety catch.

To close the bonnet, push down to the safety catch position, push in the two levers and turn clockwise.

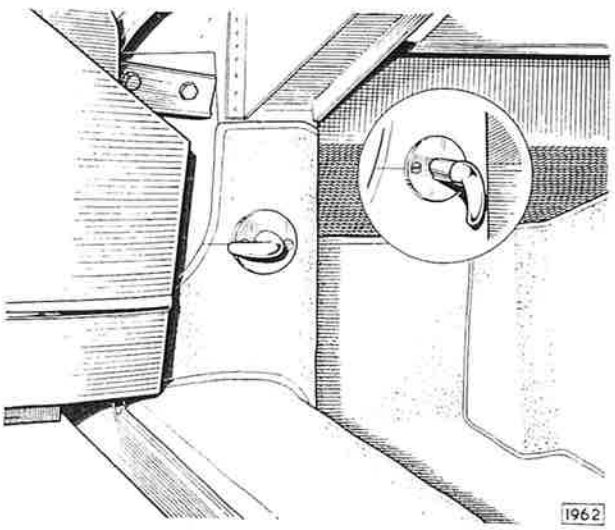

Fig. 10. Unlocking the bonnet (later cars)

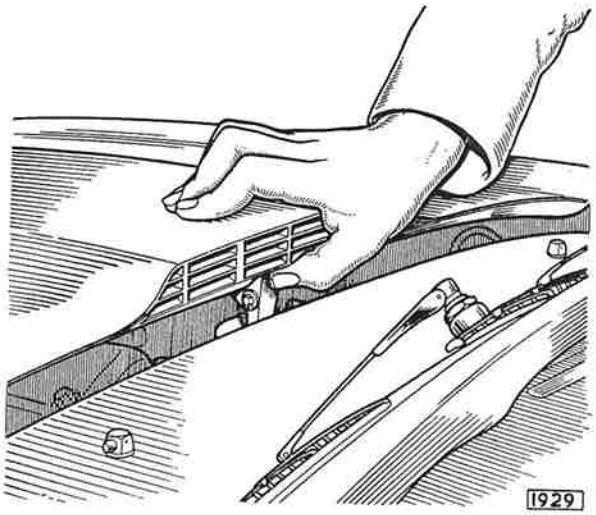

Fig. 11. Releasing the bonnet safety catch

Radiator Fan

The radiator fan is electrically driven, the cutting in speed being controlled automatically by means of a thermostatic switch incorporated in the engine cooling system. The fan will not operate with the ignition switched off.

When the coolant reaches a temperature of approximately 80°C., the thermostatic switch closes and starts the fan motor. The fan motor will continue to run until the temperature has fallen below approximately 72°C.

For full information on the Radiator Fan see "Cooling System (Section D)".

Interior Driving Mirror (Open 2-seater)

This is of the dipping type. Move lever, situated under mirror, forward for night driving, to avoid being dazzled by the lights of a following car.

Interior Driving Mirror (Fixed Head Coupe)

This is of the dipping type. Move lever, situated under the mirror, to the left for night driving, to avoid being dazzled by the lights of a following car.

Fuel Tank Filler

The fuel tank filler is situated in a recess in the left-hand rear wing and is provided with a hinged cover.

Luggage Compartment (Open 2-seater)

The luggage compartment is unlocked by pulling the black knob situated inside the car on seat back panel right-hand side.

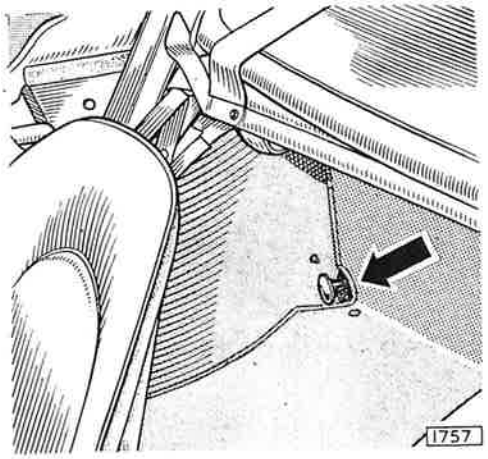

Fig. 12. Luggage compartment lock control (Open 2-seater)

Luggage Compartment (Fixed Head Coupe)

The luggage compartment is unlocked by lifting the recessed chromium plated lever situated in body trim panel beside right-hand seat. To operate, insert finger in recess and lift out lever to full extent. Retain the lid in the open position by means of the prop.

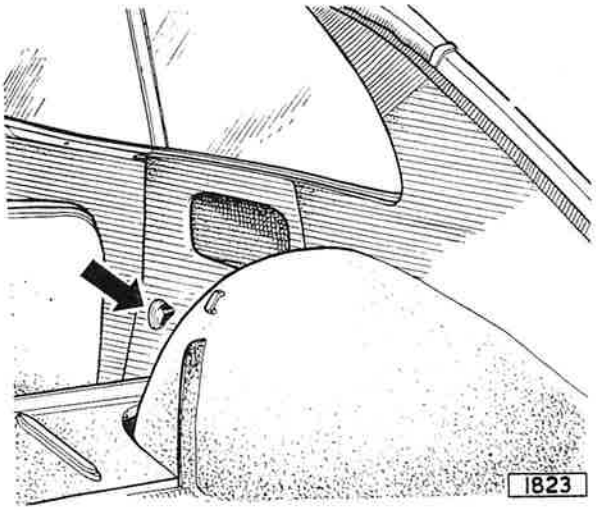

Fig. 13. Luggage compartment lock control (Fixed Head Coupe)

Seat Back Panel

The back panel behind the seat normally serves as a partition between the driving and luggage compartment. The panel can be lowered to give an increased boot floor area if required for extra storage.

To lower panel, release the two side fixing bolts and lower panel to check strap limits. Return panel to vertical position when extra boot space is not required.

Spare Wheel and Jacking Equipment

The spare wheel is housed in a well under the luggage compartment, and is accessible after removal of the square lid.

The copper hammer and jack are retained in clips in the luggage compartment. The jack handle is retained in clips under the spare wheel.

Tools

The tools are contained in a tool roll placed in the spare wheel compartment.

WHEEL CHANGING

Whenever possible the wheel changing should be carried out with the car standing on level ground, and in all cases with the handbrake fully applied.

Unlock the luggage compartment by pulling the black knob situated inside car at right-hand side of seat back panel.

The spare wheel is housed in a compartment underneath the luggage boot floor; the wheel changing equipment is retained in clips.

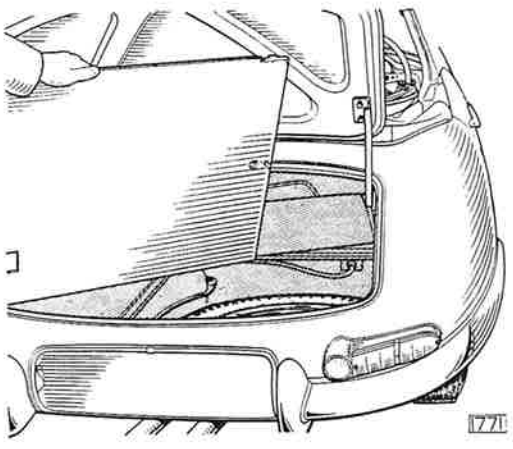

Fig. 14. Spare Wheel Housing (Open 2-seater)

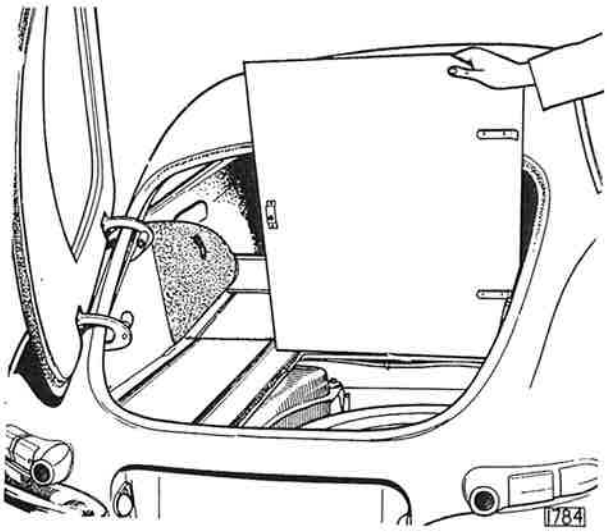

Fig. 15. Spare wheel housing (Fixed Head Coupe)

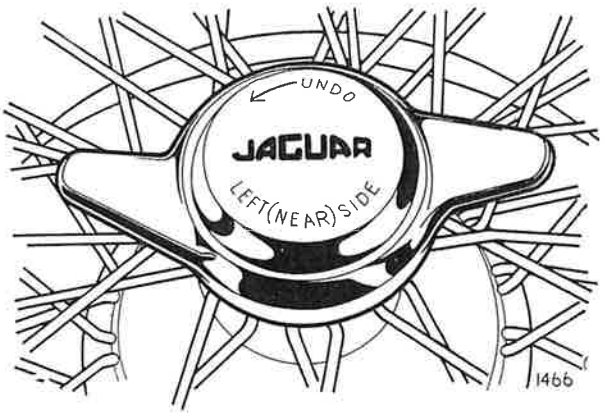

Fig. 17. Hub cap—left hand side

Remove the copper and hide mallet from the tool kit. Using the mallet, slacken but do not remove the hub caps; the hub caps are marked Right (off) side or Left (near) side, and the direction of rotation to remove, that is, clockwise for the right-hand side and anti-clockwise for the left-hand side.

The jacking sockets will be found centrally located on either side of the car. Place jack under car with pad located in the socket and raise car until wheels are clear of ground. Remove hub cap and withdraw wheel. Mount the spare wheel on the splined hub. Refit the hub cap and tighten as much as possible by rotating cap in the required direction, that is, anti-clockwise for the right-hand side and clockwise for the left-hand side.

Lower the jack and finally tighten the hub fully with the copper and hide mallet.

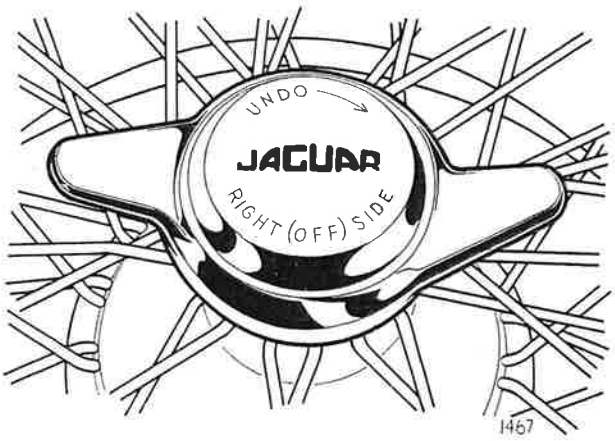

Fig. 16. Hub cap—right-hand side

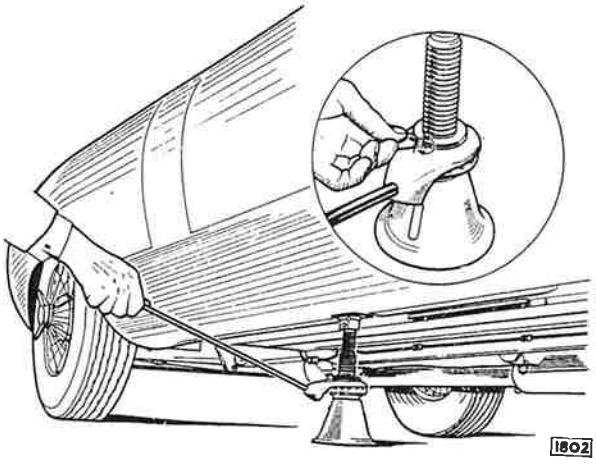

Fig. 18. The jack in position for raising the left-hand side of the car. The position of the lever shown in the inset controls the operation of the jack screw

STARTING AND DRIVING

Prior to Starting

Ensure that the coolant level in the radiator and the oil level in the sump are correct. Check for sufficient petrol in the tank.

Starting from Cold

A manual mixture control is provided located in facia panel behind steering wheel. This control has six positions; the "fully rich" position being at the top of the slide marked "COLD". Moving the lever progressively downwards weakens the mixture strength. The two positions from "HOT" give a fast idle condition; the last position "RUN" being off.

A red warning light is incorporated in the control which lights up immediately the lever is moved from "RUN" position.

When starting from cold the mixture control should be moved to the fully rich "COLD" position. Switch on the ignition and press the starter button, but do not touch the accelerator. Release the starter button as soon as the engine fires—this is important. If for any reason the engine does not start do not operate the starter button again until both the engine and the starter motor have come to rest.

As soon as the engine speed increases slide the control progressively to the intermediate "HOT" position.

Drive off at a moderate speed progressively sliding the mixture control to the "RUN" position until the knob is at the bottom of the slide and the red warning light is extinguished.

Always return the control to "RUN" position as soon as possible. Unnecessary use of the mixture control will result in reduced engine life.

Starting in Moderate Temperature

In warm weather or if the engine is not absolutely cold, it is usually possible to start the engine with the mixture control in one of the intermediate "HOT" positions. Do not touch the accelerator pedal.

Starting When Hot

Do not use the mixture control. If the engine does not start immediately slightly depress the accelerator pedal when making the next attempt.

Warming Up

Do not operate the engine at a fast speed when first started but allow time for the engine to warm up and the oil to circulate. A thermostat is incorporated in the cooling system to assist rapid warming up. In very cold weather run the engine at 1,500 r.p.m. with the car stationary until a rise in temperature is indicated on the temperature gauge.

Driving

(a) Careful adherence to the "Running-in" Instructions given will be amply repaid by obtaining the best performance and utmost satisfaction from the car.

(b) The habit should be formed of reading the oil pressure gauge, water temperature gauge and ammeter occasionally as a check on the correct functioning of the car. Should an abnormal reading be obtained an investigation should be made immediately.

(c) Always start from rest in first or second gear; on a hill always use first gear. To start in a higher gear will cause excessive clutch slip and premature wear. Never drive with a foot resting on the clutch pedal and do not keep the clutch depressed for long periods in traffic.

(d) The synchromesh gearbox provides a synchronized change in second, third and top. When changing gear the movement should be slow and deliberate.

When changing down a smoother gear change will be obtained if the accelerator is left depressed to provide the higher engine speed suitable to the lower gear. Always fully depress the clutch pedal when changing gear.

(e) Gear changing may be slightly stiff on a new car but this will disappear as the gearbox becomes "run-in".

(f) Always apply the footbrake progressively; fierce and sudden application is bad for the car and tyres. The handbrake is for use when parking the car, when driving away on a hill and when at a standstill in traffic.

"Running-in" Instructions

Only if the following important recommendations are observed will the high performance and continued good running of which the Jaguar is capable be obtained.

During the "running-in" period do not allow the engine to exceed the following speeds and particularly do not allow the engine to labour on hills; it is preferable to select a lower gear and use a higher speed rather than allow the engine to labour at low speed:—

First 1,000 miles (1,600 km.) .. .. 2,500 r.p.m.
From 1,000—2,000 miles (1,600—3,200 km.) .. .. 3,000 r.p.m.

Have the engine sump drained and refilled and the oil filter attended to as recommended at the free service, that is, after the first 500 miles (800 km.).

SUMMARY OF MAINTENANCE

Daily

Check radiator coolant level.

Check engine oil level.

Weekly

Check tyre pressures.

Check fluid level in brake and clutch master cylinder reservoirs.

Monthly

Check battery electrolyte level and connections.

Every 2,500 miles (4,000 km.)

Drain engine sump and refill.

Clean oil filter element.

Check gearbox oil level and top-up if necessary.

Check rear axle oil level and top-up if necessary.

Lubricate steering housing.

Lubricate steering tie-rod ball joints.

Lubricate wheel swivels.

Lubricate propeller shaft universal joints (early cars).

Lubricate propeller shaft splines (early cars).

Lubricate carburetter hydraulic piston dampers.

Lubricate rear half shaft universal joints.

Lubricate distributor and check contact points.

Clean, adjust and test sparking plugs.

Check clutch free travel and adjust if necessary.

Check handbrake adjustment (early cars only).

Check carburetter slow running.

Change over road wheels.

Every 5,000 miles (8,000 km.)

Carry out 2,500 miles service

Clean carburetter filters.

Clean fuel line filter.

Lubricate door hinges.

Check dynamo belt and adjust if necessary.

Renew oil filter element.

Examine brake friction pads for wear.

Clear drain holes in bottoms of doors.

Adjust top timing chain (if required).

Check front wheel alignment.

Lubricate rear suspension wishbone pivot bearings.

Carry out oil can lubrication of (a) seat runners and adjusting mechanism, (b) handbrake lever ratchet, (c) door locks, (d) boot hinges and lock, (e) bonnet hinges and catches, (f) windscreen wiper arms, (g) accelerator linkage, (h) fuel filler cover hinge, (i) handbrake cable compensator, (j) brake pedal bearing, (k) carburetter linkage.

Lubricate generator end bush (later cars only).

Every 10,000 miles (16,000 km.)

Carry out the 2,500 miles and 5,000 miles service.

Drain and refill gearbox.

Drain and refill rear axle.

Lubricate wheel hub bearings.

Check and tighten all chassis and body nuts, screws and bolts.

Renew air cleaner element.

Check wheel bearing end float and adjust if necessary.

Renew sparking plugs.

Clean fuel tank filter.

RECOMMENDED LUBRICANTS

Component	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Engine	Mobiloil Special*	Castrolite* or Castrol XL	Shell Super Oil	Esso Extra Motor Oil 5W/20*† Esso Extra Motor Oil 10W/30*† Esso Extra Motor Oil 20W/40*†	Viscostatic	Q20–50 or Q5500*	Havoline 20W/40 or 10W/30*
Upper cylinder lubrication	Mobile upper lube	Castrollo	Shell UCL or Donax U	Esso UCL	UCL	Adcoid Liquid	Regent UCL
Gearbox Distrubutor oil can points Oil can lubrication	Mobiloil A	Castrol XL	X-100 30	Esso Motor Oil 20W/30	Energol SAE 30	NOL 30	Havoline 30
Rear Axle	Mobilube GX90	Castrol Hypoy	Spirax 90 E.P.	Esso Gear Oil G.P.90/140	Gear Oil SAE 90EP	Hypoid 90	Multigear Lubricant EP 90
Propeller shafts Rear axle half shafts Front wheel bearings Rear wheel bearings Distributor cam	Mobil-grease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L.2	LB 10	Marfak All purpose
Steering housing Steering tie-rods Wheel swivels Door hinges Rear wishbone pivots	Mobil-grease MP	Castrolease LM	Retinax A	Esso Multi-purpose Grease H	Energrease L.2	LB 10	Marfak All purpose

*These oils should not be used in worn engines requiring overhaul. If an SAE 30 or 40 oil has previously been used in the engine, a slight increase in oil consumption may be noticed but this will be compensated by the advantages gained.

†According to availability in country of operation.

RECOMMENDED HYDRAULIC FLUIDS

Braking System and Clutch Operation

Preferred Fluid
Dunlop Disc Brake Fluid
(S.A.E. 70 R3)

Alternative Fluids
Recognised brands of brake fluid conforming to specification SAE 70 R3, such as Castrol, Girling Crimson Brake Fluid or Lockheed Super Heavy Duty Brake Fluid.

CONVERSION TABLES

METRIC INTO ENGLISH MEASURE

1 millimetre is approximately $^1/_{25}$", and is exactly ·03937".
1 centimetre is approximately $\frac{3}{8}$", and is exactly ·3937".
1 metre is approximately 39$\frac{3}{8}$", and is exactly 39·37" or 1·0936 yards.
1 kilometre is approximately $\frac{5}{8}$ mile, and is exactly ·6213 miles.
1 kilogramme is approximately 2$\frac{1}{4}$ lbs., and is exactly 2·21 lbs.
1 litre is approximately 1$\frac{3}{4}$ pints, and is exactly 1·76 pints.
To convert metres to yards, multiply by 70 and divide by 64.
To convert kilometres to miles, multiply by 5 and divide by 8 (approx.)
To convert litres to pints, multiply by 88 and divide by 50.
To convert grammes to ounces, multiply by 20 and divide by 567.
To find the cubical contents of a motor cylinder, square the diameter (or bore), multiply by 0·7854 and multiply the result by the stroke.
1 M.P.G.—0·3546 kilometres per litre or 2.84 litres per kilometre.

MILES INTO KILOMETRES

Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles	Kilo.	Miles
1	$\frac{5}{8}$	16	10	31	19$\frac{1}{4}$	46	28$\frac{5}{8}$	60	37$\frac{1}{4}$
2	1$\frac{1}{4}$	17	10$\frac{5}{8}$	32	19$\frac{7}{8}$	47	29$\frac{1}{4}$	70	43$\frac{1}{2}$
3	1$\frac{7}{8}$	18	11$\frac{1}{4}$	33	20$\frac{1}{2}$	48	29$\frac{7}{8}$	80	49$\frac{3}{4}$
4	2$\frac{1}{2}$	19	11$\frac{3}{4}$	34	21$\frac{1}{8}$	49	30$\frac{1}{2}$	90	55$\frac{7}{8}$
5	3$\frac{1}{8}$	20	12$\frac{3}{8}$	35	21$\frac{3}{4}$	50	31$\frac{1}{8}$	100	62$\frac{1}{8}$
6	3$\frac{3}{4}$	21	13	36	22$\frac{3}{8}$	51	31$\frac{3}{4}$	200	124$\frac{1}{4}$
7	4$\frac{3}{8}$	22	13$\frac{5}{8}$	37	23	52	32$\frac{1}{4}$	300	186$\frac{3}{8}$
8	5	23	14$\frac{1}{4}$	38	23$\frac{5}{8}$	53	32$\frac{7}{8}$	400	248$\frac{1}{2}$
9	5$\frac{5}{8}$	24	14$\frac{7}{8}$	39	24$\frac{1}{4}$	54	33$\frac{1}{2}$	500	310$\frac{3}{4}$
10	6$\frac{1}{4}$	25	15$\frac{1}{2}$	40	24$\frac{7}{8}$	55	34$\frac{1}{8}$	600	372$\frac{7}{8}$
11	6$\frac{7}{8}$	26	16$\frac{1}{8}$	41	25$\frac{1}{2}$	56	34$\frac{3}{4}$	700	435
12	7$\frac{1}{2}$	27	16$\frac{3}{4}$	42	26$\frac{1}{8}$	57	35$\frac{3}{8}$	800	497$\frac{1}{8}$
13	8$\frac{1}{8}$	28	17$\frac{3}{8}$	43	26$\frac{3}{4}$	58	36	900	559$\frac{1}{4}$
14	8$\frac{3}{4}$	29	18	44	27$\frac{3}{8}$	59	36$\frac{5}{8}$	1000	621$\frac{3}{8}$
15	9$\frac{3}{8}$	30	18$\frac{5}{8}$	45	28				

PINTS AND GALLONS TO LITRES

Pints	Gallons	Litres Approx.	Litres Exact	Pints	Gallons	Litres Approx.	Litres Exact
1	$\frac{1}{8}$	$\frac{1}{2}$	·57	40	5	23	22·75
2	$\frac{1}{4}$	1	1·14	48	6	27	27·30
3	$\frac{3}{8}$	1$\frac{1}{2}$	1·71	56	7	32	31·85
4	$\frac{1}{2}$	2$\frac{1}{4}$	2·27	64	8	36$\frac{1}{2}$	36·40
8	1	4$\frac{1}{2}$	4·54	72	9	41	40·95
16	2	9	9·10	80	10	45$\frac{1}{2}$	45·50
24	3	13$\frac{1}{2}$	13·65	88	11	50	50·05
32	4	18	18·20	96	12	54$\frac{1}{2}$	54·60

GENERAL INFORMATION

RELATIVE VALUE OF MILLIMETRES AND INCHES

mm.	Inches	mm.	Inches	mm.	Inches	mm.	Inches
1	0·0394	26	1·0236	51	2·0079	76	2·9922
2	0·0787	27	1·0630	52	2·0473	77	3·0315
3	0·1181	28	1·1024	53	2·0866	78	3·0709
4	0·1575	29	1·1417	54	2·1260	79	3·1103
5	0·1968	30	1·1811	55	2·1654	80	3·1496
6	0·2362	31	1·2205	56	2·2047	81	3·1890
7	0·2756	32	1·2598	57	2·2441	82	3·2284
8	0·3150	33	1·2992	58	2·2835	83	3·2677
9	0·3543	34	1·3386	59	2·3228	84	3·3071
10	0·3937	35	1·3780	60	2·3622	85	3·3465
11	0·4331	36	1·4173	61	2·4016	86	3·3859
12	0·4724	37	1·4567	62	2·4410	87	3·4252
13	0·5118	38	1·4961	63	2·4803	88	3·4646
14	0·5512	39	1·5354	64	2·5197	89	3·5040
15	0·5906	40	1·5748	65	2·5591	90	3·5433
16	0·6299	41	1·6142	66	2·5984	91	3·5827
17	0·6693	42	1·6536	67	2·6378	92	3·6221
18	0·7087	43	1·6929	68	2·6772	93	3·6614
19	0·7480	44	1·7323	69	2·7166	94	3·7008
20	0·7874	45	1·7717	70	2·7559	95	3·7402
21	0·8268	46	1·8110	71	2·7953	96	3·7796
22	0·8661	47	1·8504	72	2·8347	97	3·8189
23	0·9055	48	1·8898	73	2·8740	98	3·8583
24	0·9449	49	1·9291	74	2·9134	99	3·8977
25	0·9843	50	1·9685	75	2·9528	100	3·9370

RELATIVE VALUE OF INCHES AND MILLIMETRES

Inches	0	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$
0	0·0	1·6	3·2	4·8	6·4	7·9	9·5	11·1
1	25·4	27·0	28·6	30·2	31·7	33·3	34·9	36·5
2	50·8	52·4	54·0	55·6	57·1	58·7	60·3	61·9
3	76·2	77·8	79·4	81·0	82·5	84·1	85·7	87·3
4	101·6	103·2	104·8	106·4	108·0	109·5	111·1	112·7
5	127·0	128·6	130·2	131·8	133·4	134·9	136·5	138·1
6	152·4	154·0	155·6	157·2	158·8	160·3	161·9	163·5
Inches	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	$\frac{11}{16}$	$\frac{3}{4}$	$\frac{13}{16}$	$\frac{7}{8}$	$\frac{15}{16}$
0	12·7	14·3	15·9	17·5	19·1	20·6	22·2	23·8
1	38·1	39·7	31·4	42·9	44·4	46·0	47·6	49·2
2	63·5	65·1	66·7	68·3	69·8	71·4	73·0	74·6
3	88·9	90·5	92·1	93·7	95·2	96·8	98·4	100·0
4	114·3	115·9	117·5	119·1	120·7	122·2	123·8	125·4
5	139·7	141·3	142·9	144·5	146·1	147·6	149·2	150·8
6	165·1	166·7	168·3	169·9	171·5	173·0	174·6	176·2

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SECTION B

ENGINE

3·8 "E" TYPE
GRAND TOURING MODELS

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ENGINE

All "E" Type models have the twin overhead camshaft XK type engine, fitted with the "S" type cylinder head with straight ports and $\frac{3}{8}$" lift camshafts.

Compression Ratio	Engine Number Prefix	Colour of Cylinder Head
8 : 1 or 9 : 1	R	Gold

Compression ratios of 8 to 1 and 9 to 1 are specified for the "E" Type engine, the differences in compression ratio being obtained by varying the crown design of the piston.

The compression ratio of an engine is indicated by /8, /9 following the engine number.

DATA

Camshaft

Number of journals	Four per shaft
Journal diameter	1·00"—·0005" —·001" (25·4 mm.—·013 mm.) —·025
Thrust taken	Front end
Number of bearings	Four per shaft (eight half bearings)
Type of bearing	White metal steel backed shell
Diameter clearance	·0005" to ·002" (·013 to ·05 mm.)
Permissible end float	·0045" to ·008" (·11 to ·20 mm.)
Tightening torque—Bearing cap nuts	15 lbs. ft. (175 lbs. ins.) (2·0 kg/m.)

Connecting Rod

Length centre to centre	$7\frac{3}{4}$" (19·68 cm.)
Big end—Bearing type	Lead bronze, steel backed shell

ENGINE

Bore for big end bearing	2·233″ to 2·2335″ (56·72 to 56·73 mm.)
Big end—Width	$1\frac{3}{16}$″—·006″ —·008″ (30·16 mm.—·15 mm.) —·20
Big end—Diameter clearance	·0015″ to ·0033″ (·04 mm. to ·08 mm.)
Big end—side clearance	·0058″ to ·0087″ (·15 mm. to ·22 mm.)
Bore for small end bush	1·00″ ± ·0005″ (25·4 mm. ± ·013 mm.)
Small end bush—Type	Phosphor bronze—steel backed
Small end—Width	$1\frac{5}{64}$″ (27·4 mm.)
Small end bush—Bore diameter	·875″ + ·0002″ —·0000″ (22·22 mm. + ·005 mm.) —·000
Tightening torque—Con rod bolts	37 lbs. ft. (450 lbs. ins.) (5·1 kg./m.)

Crankshaft

Number of main bearings	Seven
Main bearing—Type	Lead bronze, steel backed shell
Journal diameter	Front, centre, rear 2·750″ to 2·7505″ (69·85 to 69·86 mm.) Intermediate 2·7495″ to 2·750″ (69·84 to 69·85 mm.)
Journal length Front	$1\frac{11}{16}$″ ± ·005″ (42·86 mm. ± ·13 mm.)
Centre	$1\frac{3}{4}$″ + ·0005″ +·001″ (44·45 mm. + ·013 mm.) +·025

Rear	$1\frac{7}{8}$″ (47·63 mm.)
Intermediate	$1\frac{7}{32}$″ ± ·002″ (30·96 mm. ± ·05 mm.)
Thrust taken	Centre bearing thrust washers
Thrust washer—Thickness	·092″ ± ·001″ and ·096″ ± ·001″ (2.33 mm. ± ·025 mm. and 2·43 mm. ± ·025 mm.)
End clearance	·004″ to ·006″ (·10 to ·15 mm.)
Main bearing—Length	
Front, Centre, Rear	$1\frac{1}{2}$″ ± ·005″ (38·1 mm. ± ·13 mm.)
Intermediate	1″ ± ·005″ (25·4 mm. ± ·13 mm.)
Diameter clearance	·0025″—·0042″ (·063 to ·106 mm.)
Crankpin—Diameter	2·086″ + ·0006″ —·000″ (52·98 mm. + ·015 mm. —·000)
Length	$1\frac{3}{16}$″ + ·0007″ —·0002″ (30·16 mm. + ·018 mm. —·006)
Regrind undersize	·010″, ·020″, ·030″ and ·040″ (·25, ·51, ·76 and 1·02 mm.)
Minimum diameter for regrind	—·040″ (1·02 mm.)
Tightening torque—main bearing bolts	83 lbs. ft. (1,000 lbs. ins.) (11·5 kg./m.)

Cylinder Block

Material	"Brivadium" dry liners

ENGINE

Cylinder bores—Nominal	87 mm. + ·0127 mm. (3·4252″ + ·0005″) — ·0064 mm. — ·00025″
Maximum rebore size	+ ·030″ (·76 mm.)
Bore size for fitting liners	3·561″ to 3·562″ (90·45 mm. to 90·47)
Outside diameter of liner	3·563″ to 3·566″ (90·50 to 90·58 mm.)
Interference fit	·001″ to ·005″ (·025 to ·125 mm.)
Overall length of liner	$6\frac{31}{32}$″ (17·7 cm.)
Outside diameter of lead-in	3·558″ to 3·560″ (90·37 to 90·42 mm.)
Size of bore honed after assembly—in cylinder block— Nominal	87 mm. (3·4252″)
Main line bore for main bearings	2·9165″ + ·0005″ — ·0000″ (74·08 + ·013 mm. — ·000 mm.)

Cylinder Head

Type	Straight Port (Gold Top)
Material	Aluminium Alloy
Valve seat angle—Inlet	45°
—Exhaust	45°
Valve throat diameter—Inlet	$1\frac{1}{2}$″ (38·1 mm.)
—Exhaust	$1\frac{3}{8}$″ (34·9 mm.)
Tightening torque—Cylinder head nuts	54 lbs. ft. (650 lbs. ins.) (7·5 kg./m.)
Firing order	1, 5, 3, 6, 2, 4 No. 1 cylinder being at the rear of the engine

Gudgeon Pin

Type	Fully floating
Length	2·840″ to 2·845″ (72·14 to 72·26 mm.)
Inside diameter	$\frac{5}{8}$″ (15·87 mm.)
Outside diameter	·8750″ to ·8752″ (22·22 to 22·23 mm.)

Lubricating System

Oil pressure (hot)	40 lbs. per sq. in. at 3,000 r.p.m.
Oil pump—Type	Eccentric rotor
—Clearance at end of lobes	·006″ maximum (·15 mm.)
—End clearance	·0025″ maximum (·06 mm.)
—Clearance between outer rotor and body	·010″ maximum (·25 mm.)

Piston and Piston Rings

Make	Brico
Type	Semi-split skirt
Piston	
Skirt clearance (*measured at bottom of skirt at 90° to gudgeon pin axis*)	·0011″ to ·0017″ (·028 to ·043 mm.)
Gudgeon pin bore	·8749″ to ·8751″ (2·223 to 2·227 mm.)

Compression height

8 : 1 compression ratio	2·069″ to 2·064″ (52·42 to 52·55 mm.)
9 : 1 compression ratio	2·247″ to 2·242″ (56·94 to 57·07 mm.)

ENGINE

Piston rings—Number	
Compression	2
Oil control	1
Piston rings—Width	
Compression	0·777″ to ·0787″ (1·97 to 2.00 mm.)
Oil Control	·155″ to ·156″ (3·94 to 3·96 mm.)
Piston rings—Thickness	
Compression	·124″ to ·130″ (3·15 to 3·30 mm.)
Oil control	·119″ to ·127″ (3·02 to 3·23 mm.)
Piston rings—Side clearance in groove	
Compression	·001″ to ·003″ (·02 to ·07 mm.)
Oil Control	·001″ to ·003″ (·02 to ·07 mm.)
Piston rings—Gap when fitted to cylinder bore	
Compression	·015″ to ·020″ (·38 to ·51 mm.)
Oil control	·011″ to ·016″ (·28 to ·41 mm.)

Sparking Plugs

Make	Champion
Type	
8 : 1 compression ratio	UN12Y*
9 : 1 compression ratio	UN12Y*
Gap	·025″ (·64 mm.)

* N.3 for racing.

Tappets and Tappet Guides

Tappet—Material	Cast iron (chilled)
—Outside diameter	1·3738″ to 1·3742″ (34·89 to 34·90 mm.)

Diameter clearance	·0008″ to ·0019″ (·02 to ·048 mm.)
Tappet guide—Material	Austenitic iron
—Inside diameter (before reaming) ..	1·353″ to 1·357″ (34·37 to 34·48 mm.)
—Reaming size (when fitted to cylinder head)	1·375″ +·0007″ —·0000″ (34·925 mm. +·018 mm. —·000)
—Interference (shrink) fit in head	·003″ (·07 mm.)

Timing Chains and Sprockets

Type	Duplex
Pitch	⅜″ (9·5 mm.)
Number of pitches—Top chain	100
—Bottom chain	82
Crankshaft sprocket—Teeth	21
Intermediate sprocket, outer—Teeth	28
Intermediate sprocket, inner—Teeth	20
Camshaft sprocket—Teeth	30
Idler Sprocket	21

Valve Timing

Inlet valve opens	15° B.T.D.C.
Inlet valve closes	57° A.B.D.C.
Exhaust valve opens	57° B.B.D.C.
Exhaust valve closes	15° A.T.D.C.
	(with valve clearances set at ·010″ (·25 mm.))

Valves and Valve Springs

Valves—Material, Inlet	Silicon chrome steel
Exhaust	Austenitic steel

ENGINE

Valve head diameter, Inlet	$1\frac{3}{4}'' \pm .002''$ (44·45 mm. ± ·05 mm.)	
Exhaust	$1\frac{5}{8}'' \pm .002''$ (41·27 mm. ·05 mm.)	
Valve stem diameter, Inlet and Exhaust	$\frac{5}{16}''$—·0025″ —·0035″ (7·95 mm.—·06 mm.) —·09 mm.)	
Valve lift	$\frac{3}{8}''$	
	Touring	**Racing**
Valve clearance—Inlet	·004″ (·10 mm.)	·006″ (·15 mm.)
—Exhaust	·006″ (·15 mm.)	·010″ ·25 mm.)
Valve seat angle—Inlet	45°	
—Exhaust	45°	
Valve spring—Free length. Inner	$1\frac{21}{32}''$ (·42 mm.)	
Outer	$1\frac{15}{16}''$ (49·2 mm.)	
Valve spring—Fitted length. Inner	$1\frac{7}{32}''$ (30·96 mm.)	
Outer	$1\frac{5}{16}''$ (33·34 mm.)	
Valve spring—Fitted load Inner	30·33 lbs. (13·76 kg.)	
Outer	48·375 lbs. (21·94 kg.)	
Valve spring—Solid length (max.) Inner	·810″ (20·57 mm.)	
Outer	·880″ (22·35 mm.)	
Number of free coils Inner	6	
Outer	5	
Diameter of wire Inner	12 SWG (·104″) (2·64 mm.)	
Outer	10 SWG (·128″) (3·25 mm.)	

Valve Guide and Valve Seat Insert

Valve guides—Material	Cast iron
Valve guide—Length, Inlet	$1\frac{13}{16}''$ (46·04 mm.)
Exhaust	$1\frac{15}{16}''$ (49·21 mm.)

Valve guide—Inside diameter—Inlet	$\frac{5}{16}$"—·0005" —·0015" (7·94 mm.—·013 mm.) —·038 mm.)
Exhaust	$\frac{5}{16}$ ± ·0005" (7·94 mm. ± ·01 mm.)
Interference fit in head	·0005" to ·0022" (·013 to ·055 mm.)
Valve seat inserts—Material	Cast iron (centrifugally cast)
Inside diameter Inlet	$1\frac{1}{2}$" + ·003" —·001" (38·1 + ·076 mm.) —·025 mm.)
Exhaust	1·379" to 1·383" (35·03 to 35·13 mm.)
Interference (shrink) fit in head ..	·003" (·076 mm.)

Recommended Lubricants

	Mobil	Castrol	Shell	Esso	B.P.	Duckham	Regent Caltex/Texaco
Engine	Mobiloil Special*	Castrolite* or Castrol XL	Shell Super Oil	Esso Extra Motor Oil 5W/20*† Esso Extra Motor Oil 10W/30*† Esso Extra Motor Oil 20W/40*†	Viscostatic	Q20–50 or Q5500*	Havoline 20W/40 or 10W/30*
Upper cylinder lubrication	Mobil Upperlube	Castrollo	Shell U.C.L. or Donax U	Esso U.C.L.	U.C.L.	Adcoid Liquid	Regent U.C.L.

*These oils should not be used in worn engines requiring overhaul. If an SAE 30 or 40 oil has previously been used in the engine, a slight increase in oil consumption may be noticed but this will be compensated by the advantages gained.

†According to availability in country of operation.

Capacities

	Imperial	U.S.	Litres
Engine (refill)	15 pints	18 pints	$8\frac{1}{2}$

ROUTINE MAINTENANCE

DAILY

Checking the Engine Oil Level

Check the oil level with the car standing on level ground otherwise a false reading will be obtained.

Remove the dipstick and wipe it dry. Replace and withdraw the dipstick; if the oil level is on the knurled patch, with the engine hot or cold, no additional oil is required. If the engine has been run immediately prior to making an oil level check, wait one minute after switching off before checking the oil level.

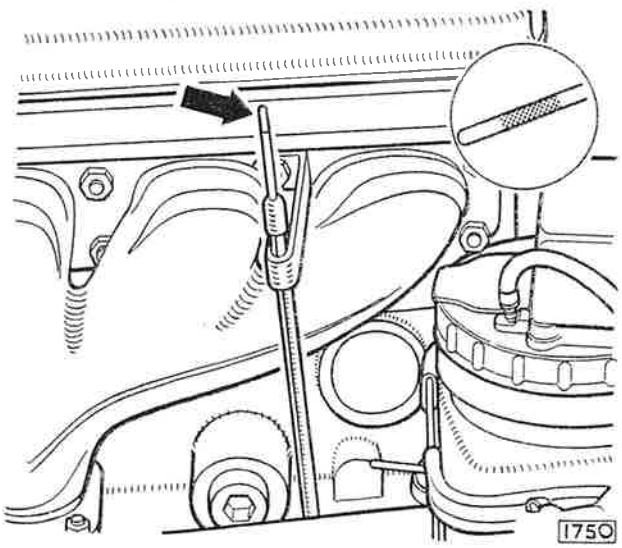


Fig. 1. Engine dipstick.

Note: Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another this should be done when the sump is drained and the Oil Company's recommendation in regard to flushing procedure should be followed.

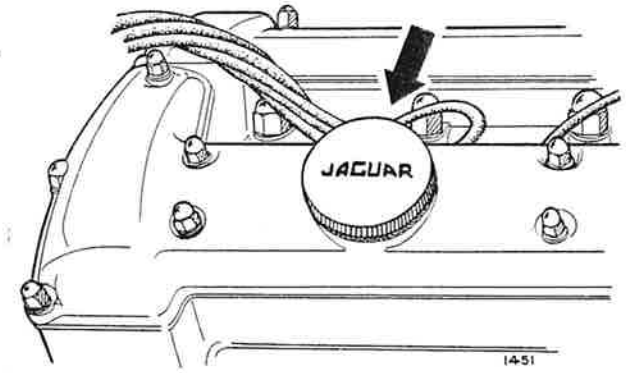


Fig. 2. Engine oil filler.

EVERY 2,500 MILES (4,000 KM.)

Changing the Engine Oil

Note: Under certain adverse operating conditions, conducive to oil dilution and sludge formation, more frequent oil changing than the normal 2,500 mile (4,000 km.) period is advised. Where the car is used mainly for low-speed city driving, stop-start driving particularly in cold weather or in dusty territory the oil should be changed at least every 1,000 miles (1,600 km.).

The draining of the sump should be carried out at the end of a run when the oil is hot and therefore will flow more freely. The drain plug is situated at the right-hand rear corner of the sump. When the engine oil is changed, the oil filter which is situated on the right-hand side of the engine, must also receive attention.

First drain the oil from the filter by removing the small hexagon-headed drain plug situated at the

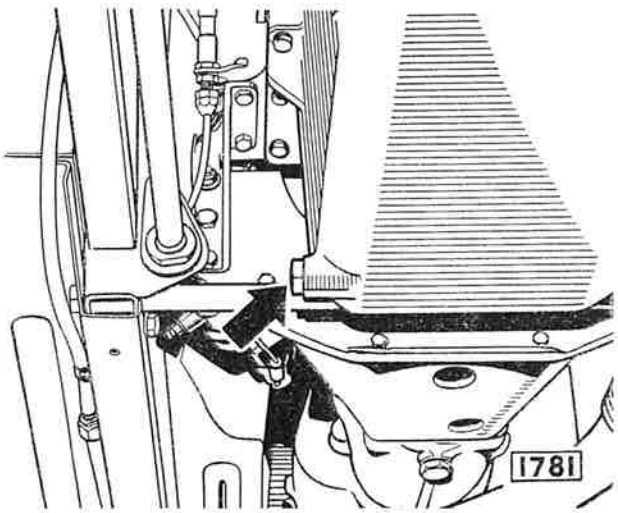


Fig. 3. Engine drain plug.

bottom of the filter head. Unscrew the central bolt and remove the canister and element. Thoroughly wash these parts in petrol and allow to dry out. When replacing the canister ensure that the circular rubber seal in the filter head has not become displaced. (Attention is drawn to the importance of renewing the filter element at 5,000 miles (8,000 km.) intervals).

Note: Almost all modern engine oils contain special additives, and whilst it is permissible to mix the recommended brands it is undesirable. If it is desired to change from one brand to another

this should be done when the sump is drained, and the Oil Company's recommendation in regard to flushing procedure should be followed.

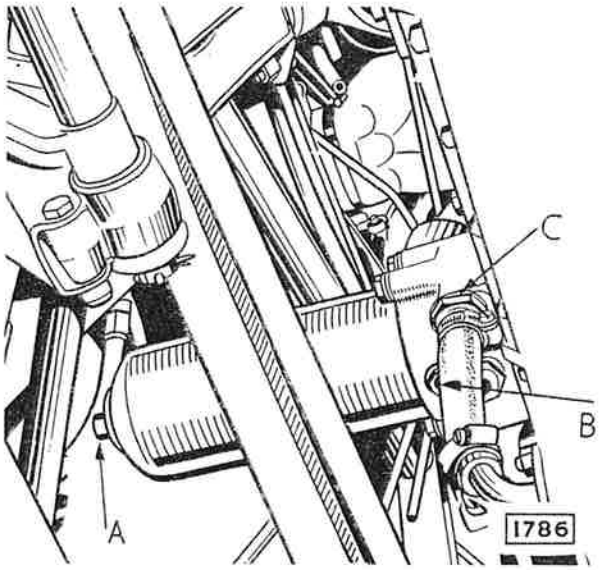


Fig. 4. Engine oil filter.
A, securing bolt; B, drain plug; C, oil pressure relief valve union

Distributor Lubrication

Take care to prevent oil or grease from getting on or near the contact breaker points.

Remove the moulded cap at the top of the distributor by springing back the two clips. Lift off the rotor arm and apply a few drops of engine oil around the screw (A Fig. 5) now exposed. It is not necessary to remove the screw as it has clearance to permit the passage of oil.

Apply **one** drop of oil to the post (B) on which the contact breaker pivots. Lightly smear the cam (C) with grease. Lubricate the centrifugal advance mechanism by injecting a few drops of engine oil through the aperture at the edge of the contact breaker base plate.

Distributor Contact Breaker Points

Check the gap between the contact points with feeler gauges when the points are fully opened by one of the cams on the distributor shaft. A combined screwdriver and feeler gauge is provided in the tool kit.

The correct gap ·014"—·016" (·36—·41 mm.).

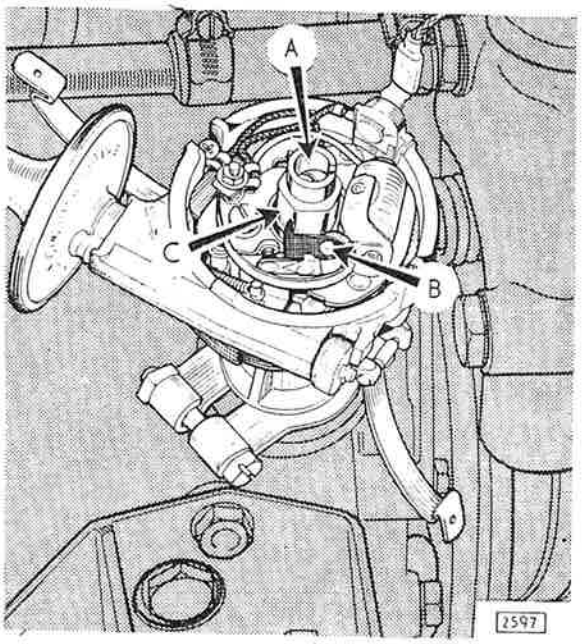


Fig. 5. Lift off the rotor arm and apply a few drops of oil around the screw 'A'. Apply one drop of oil to post 'B'. Lightly smear the cam 'C' with grease.

If the gap is incorrect, slacken the two screws (A Fig. 6) securing the fixed contact plate and turn the eccentric-headed adjustment screw (B) in its slot until the required gap is obtained. Tighten the securing screws and re-check the gap.

Examine the contact breaker points. If the contacts are burned or blackened, clean them with a fine carborundum stone or very fine emery cloth. After-

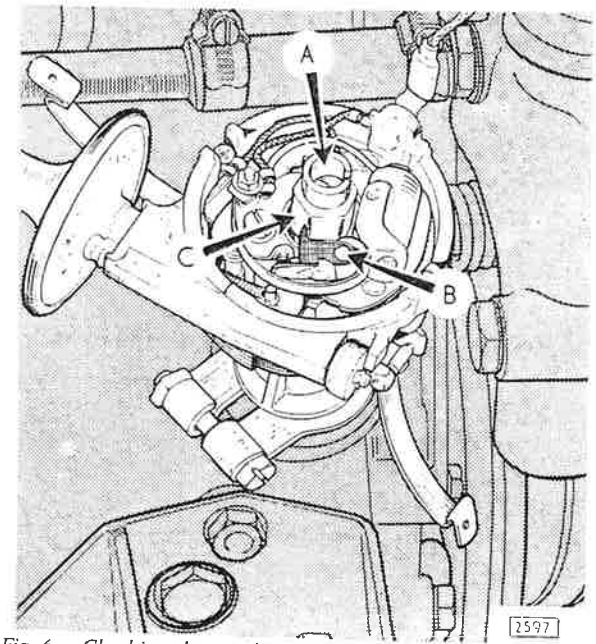


Fig. 6. Checking the gap between the distributor contact points. The two screws 'A' secure the fixed contact plate; the contact gap is adjusted by means of the eccentric headed screw 'B'.

wards wipe away any trace of grease or metal dust with a petrol moistened cloth.

Cleaning of the contacts is made easier if the contact breaker lever carrying the moving contact is removed. To do this, remove the nut, insulating piece and connections from the post to which the end of the contact breaker spring is anchored. The contact breaker lever can now be lifted off its pivot post.

Sparking Plugs

Every 2,500 miles (4,000 km.) or more often if operating conditions demand, withdraw, clean and reset the plugs.

The only efficient way to clean sparking plugs is to have them properly serviced on machines specially designed for this purpose. These machines operate with compressed air and utilise a dry abrasive material specially graded and selected to remove harmful deposits from the plug insulator without damaging the insulator surface. In addition the majority of the machines incorporate electrical testing apparatus enabling the plugs to be pressure tested to check their electrical efficiency and gas tightness.

The gap between the points should be ·025" (·64 mm.). When adjusting the gap always move the side wire—never bend the centre wire.

The Champion Sparking Plug Co. supply a special combination gauge and setting tool, the use of which is recommended.

Every 10,000 miles (16,000 km.) a new set of plugs of the recommended type should be fitted. To save petrol and to ensure easy starting, the plugs should be cleaned and tested regularly.

EVERY 5,000 MILES (8,000 KM.)

Water Pump/Dynamo Belt Tension—(Early Cars)

When the belt is correctly tensioned it should be possible to depress the belt about half an inch (12 mm.) midway between the water pump and dynamo pulleys.

Adjustment is effected by slackening the three dynamo mounting bolts, moving the dynamo until the correct tension is obtained and tightening the bolts.

Do not overtighten the belt or this will cause undue wear of the belt and the water pump and dynamo bearings. Slackness of the belt may cause slippage with the possible result of a squealing noise from the belt and a reduced charging rate from the dynamo.

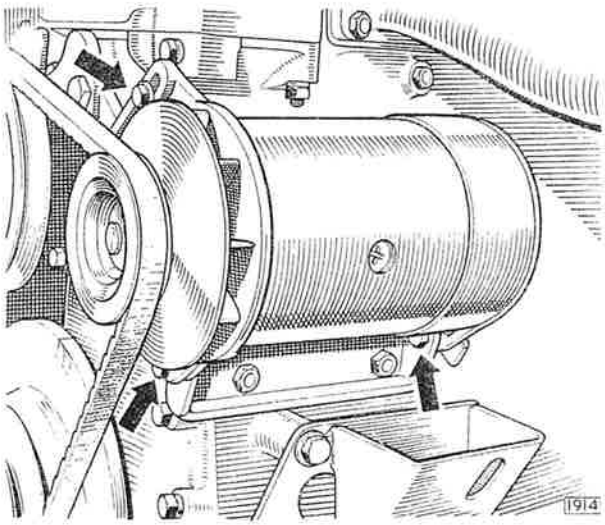


Fig. 7. To adjust the fan belt tension, slacken the three dynamo mounting bolts and move the dynamo to the desired position.

Later Cars

Dynamo and Water Pump Belt Replacement

The dynamo and water pump belt is kept at the correct tension by means of a spring loaded jockey pulley on the right hand side of the engine. If the belt has to be replaced carry out the following procedure:–

Slacken the two bolts securing the dynamo to the mounting bracket. Remove the nut and unscrew the bolt securing the top dynamo link to the dynamo. Slacken the bolt securing the dynamo link to the engine and press the dynamo as far as possible towards the engine. Place the new belt in position on the water pump, jockey and crankshaft pulleys and by pressing the jockey pulley towards the engine pass the belt over the dynamo pulley. Pass the dynamo securing top bolt through the link and screw into the lug of the dynamo. Pull the dynamo away from the engine as far as possible and tighten the top dynamo securing bolt and replace the lock nut. Tighten the bolt securing the dynamo link to the engine and also the two bottom dynamo mounting bolts.

Oil Filter Element

It is most important to renew the oil filter element every 5,000 miles (8,000 km.) as after this mileage it will have become choked with impurities.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows **unfiltered** oil to by-pass the element and reach bearings. This will be accompanied by a drop in the normal oil pressures of some 10 lb.

per sq. in. and if this occurs the filter element should be renewed as soon as possible.

The oil filter is situated on the right-hand side of the engine and before removing the canister it will be necessary to drain the filter by removing the small hexagon-headed drain plug situated at the bottom of the filter head.

To gain access to the element, unscrew the central bolt when the canister complete with the element can be removed. Thoroughly wash out the canister with petrol and allow to dry before inserting the new element.

When replacing the canister ensure that the circular rubber seal in the filter head has not become displaced.

Top Timing Chain Tension

If the top timing chain is audible adjust the tension as follows:—

This operation requires the use of a special tool to enable the adjuster plate to be rotated. To gain access to the adjuster plate remove the breather housing attached to the front face of the cylinder head.

Slacken the locknut securing the serrated adjuster plate. Tension the chain by pressing the locking plunger inwards and rotating the adjuster plate in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is, the chain must not be dead tight. Release locking plunger, and securely tighten locknut. Refit the breather housing.

EVERY 10,000 MILES (16,000 KM.)

Air Cleaner

The air cleaner is of the paper element type and is situated in the engine compartment on the right-hand side adjacent to the carburetters.

No maintenance is necessary, but the element should be renewed every 10,000 miles (16,000 km.) or more frequently in dusty territories. To gain access to the element release the three spring clips retaining top cover to base. Remove two wing nuts attaching cleaner to air box and lift out element and cover. Remove serrated nut, and retainer plate from base of unit and withdraw element.

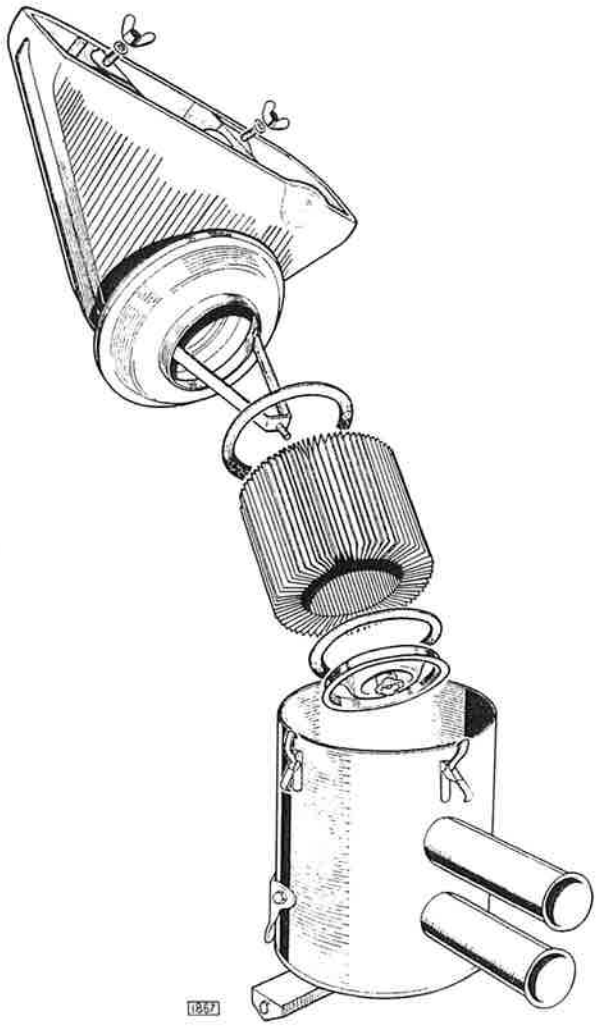


Fig. 8. The air cleaner.

FUEL REQUIREMENTS FOR 9 TO 1 and 8 TO 1 COMPRESSION RATIO ENGINES

If the engine of your car is fitted with 9 to 1 compression ratio pistons (indicated by /9 after the engine number) use only Super grade fuel with a minimum octane rating of 98. (Research method.) If a car is fitted with 8 to 1 compression ratio pistons (indicated by /8 after the engine number) use premium grade fuel with a minimum rating of 91. (Research method).

If, of necessity, the car has to be operated on lower octane fuel do not use full throttle otherwise detonation may occur with resultant piston trouble.

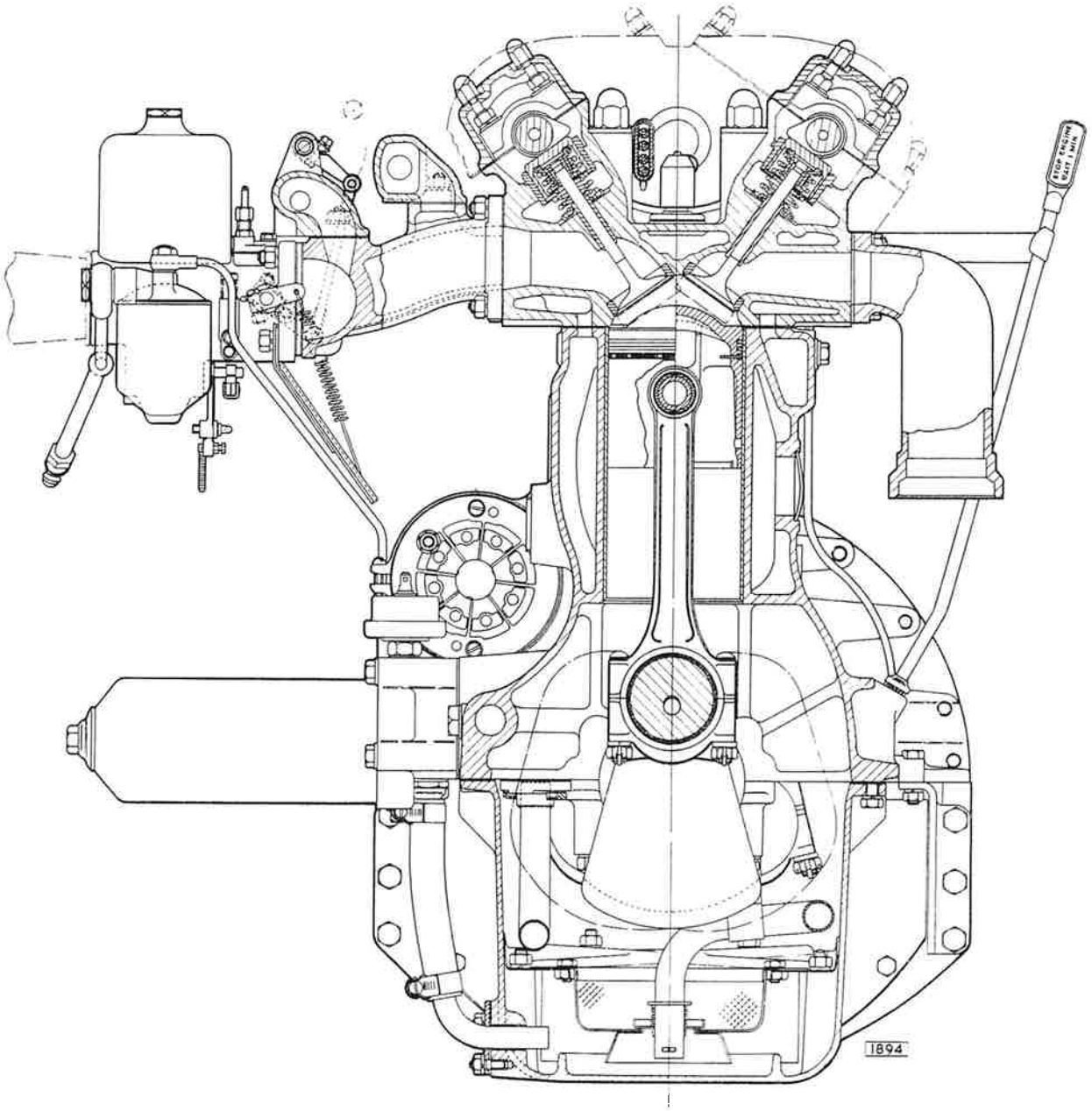


Fig. 9. Cross sectional view of the engine.

ENGINE REMOVAL

ENGINE REMOVAL

Remove the bonnet (for details see Section N.).

Disconnect the battery.

Drain the cooling system by turning the radiator drain tap and removing the filler cap. Conserve coolant if anti-freeze is in use.

Slacken the clip on the breather pipe, unscrew the two wing nuts and remove the top of the air cleaner.

Disconnect the petrol feed pipe below the centre carburetter.

Slacken the clips securing the water hoses from the cylinder head and radiator to the header tank.

Slacken the clips securing the heater hoses to the manifold.

Disconnect the brake vacuum pipe.

Disconnect the two electrical connections from the fan control thermostat in the header tank together with the anchoring clip.

Remove the two nuts and bolts securing the header tank mounting bracket to the front cross member.

Disconnect the radiator header tank overflow pipe and remove the header tank complete with mounting bracket.

Disconnect the throttle linkage at the rear carburetter.

Remove the green/blue cable from the water temperature transmitter.

Remove the white/black cable from the distributor to the C.B. coil terminal and the white cable from the S.W. coil terminal.

Disconnect the battery cable and the solenoid switch cable from the starter motor.

Remove the bolt from the oil filter canister and remove the canister, together with the filter, from below ensuring that the rubber sealing ring is renewed when refitting.

Remove the lower crankshaft pulley, complete with the crankshaft damper and drive belt. Remove the ignition timing pointer from the sump. Mark the pulley and the damper to facilitate refitting.

Remove the upper clip from the water pump hose.

Remove the white and brown cable from the oil pressure element.

Remove the revolution counter generator complete with cables.

Disconnect the brown/yellow cable from the "D" terminal on the dynamo and the brown/green cable from the "F" terminal.

Remove the four nuts and washers securing each downpipe to the exhaust manifold, unclip the downpipes at the silencer assembly and withdraw the pipes. Collect the sealing rings between the exhaust manifolds and the downpipes.

Remove the seats, radio (if fitted) and the ash tray.

Remove the three setscrews securing the propeller shaft tunnel cover to the body.

Apply the handbrake and remove the gear lever knob.

Slide the propeller shaft tunnel cover over the handbrake and gear levers. Withdraw the tunnel cover.

Turn back the carpet. Withdraw the plastic gearbox bellows having removed the six drive screws. Remove trim and screws securing the gearbox cover. Remove gearbox cover and the gear lever.

Remove the engine rear mounting plate.

Remove the four bolts and self-locking nuts securing the front propeller shaft universal joint to the gearbox flange.

Remove the torsion bar reaction tie plate from beneath the car using either a ramp or pit.

Remove the two cables from the reverse light switch on the gearbox top cover. When refitting, these cables can be fitted to either terminal.

Remove the engine earth strap from the left hand side member.

Disconnect the clutch slave cylinder.

Support the engine by means of lifting tackle, utilizing the lifting straps (later cars) or the engine lifting plate (Churchill Tool No. J.8) in the case of early cars and by inserting the trolley jack under the gearbox from the front of the car.

Remove the self-locking nut and stepped washer from the engine stabiliser.

Remove the bolts from the front engine mountings.

Remove the speedometer cable.

Raise the engine on the lifting tackle and, keeping the engine level, move it towards the front of the car ensuring that the water pump pulley clears the subframe top cross member and that the bell housing clears the anchor brackets at the rear of the torsion bars.

Gradually lifting the front of the engine and lowering the rear, withdraw the engine from the front.

When withdrawing the engine ensure that the rears

of the camshaft covers do not foul the bonnet drain channel and that the brake pipe is not damaged.

REFITTING

Refitting the engine is the reverse of the removal procedure.

Note: Care must be taken to ensure that the brake pipes are not damaged at the front sub-frame cross members and that the engine does not foul the torsion bar anchor brackets or displace the silver steel locating bars.

Replace the exhaust manifold sealing rings and if the cylinder head nuts have been removed they should be tightened to a torque of 54 lb.ft. (7·4 kgm.). Bleed the clutch hydraulic system, reset the manual mixture control and adjust the engine stabiliser.

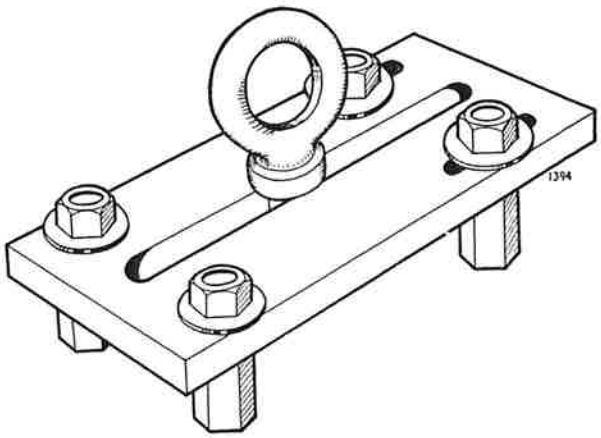


Fig. 11. The engine lifting plate (Churchill Tool No. J.8.). On later cars, engine lifting straps are fitted to the cylinder head.

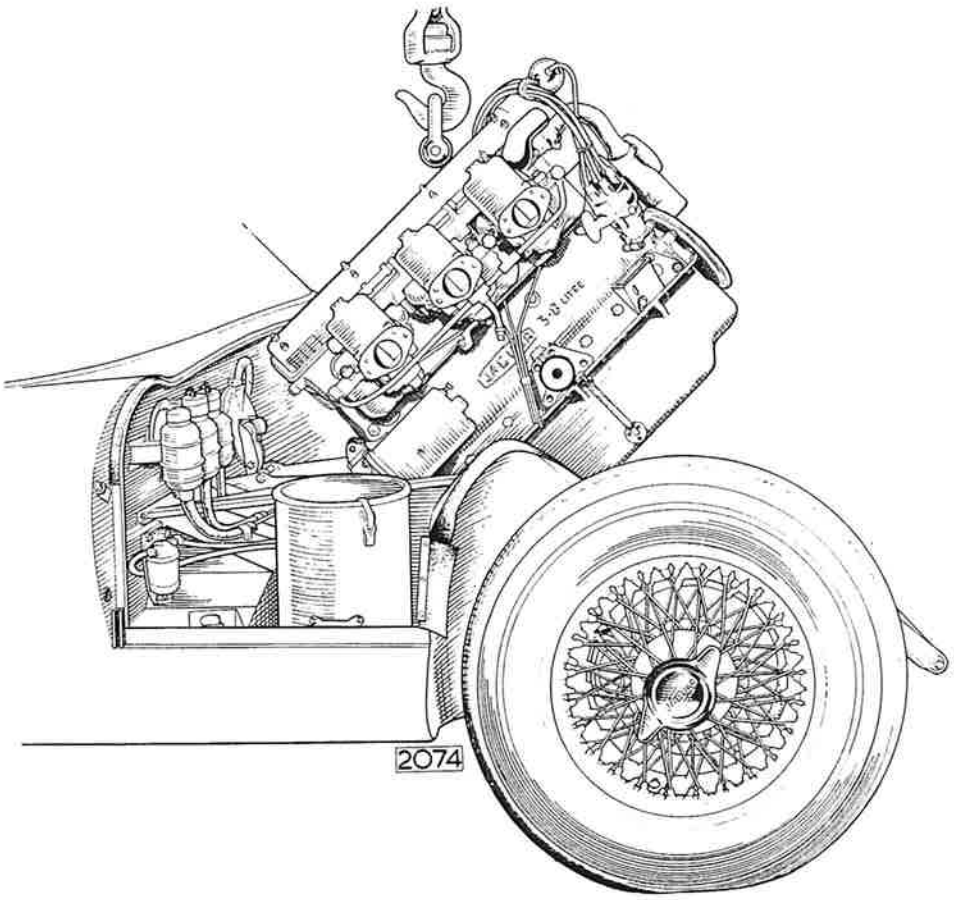


Fig. 10. Removing the engine from above.

ENGINE TO DISMANTLE

GENERAL

The following instructions apply when the engine components are removed in the following sequence with the engine unit out of the chassis. Dismantling of sub-assemblies and the removal of individual components when the engine is in the chassis frame are dealt with separately in this section.

All references made in this section to the top or bottom of the engine assume the engine to be in the normal upright position. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

REMOVE STARTER

Unscrew the two nuts securing the starter to the clutch housing and withdraw the starter.

REMOVE GEARBOX

Unscrew the four setscrews and remove the cover plate from the front face of the clutch housing.

Remove the set bolts and nuts securing the clutch housing to the engine and withdraw the gearbox unit. The gearbox must be supported during this operation in order to avoid straining the clutch driven plate and constant pinion shaft.

REMOVE DISTRIBUTOR

Spring back clips and remove the cover complete with high tension leads. Disconnect the electrical cable from the distributor. Slacken the clamp plate bolt and withdraw distributor. Remove the setscrew and remove the clamp plate. Note the cork seal in recess at the top of the distributor drive hole.

REMOVE CYLINDER HEAD

Disconnect the distributor vacuum feed pipe from the front carburetter. Remove the high tension leads from the sparking plugs and lead carrier from the cylinder head studs. Remove the sparking plugs. Disconnect the camshaft oil feed pipe from the rear of the cylinder head. Remove the eleven dome nuts from each camshaft cover and lift off the covers.

Remove the four dome nuts securing the breather housing and withdraw housing. Release the tension on the camshaft chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring-loaded stop peg and rotating serrated adjuster plate clockwise. Anti-clockwise rotation of the serrated adjuster viewed from the front of the engine tightens the chain.

Break the locking wire on the two setscrews securing the camshaft sprockets to their respective camshafts.

Remove the setscrews and withdraw the sprockets from the camshafts with chain in position. Having

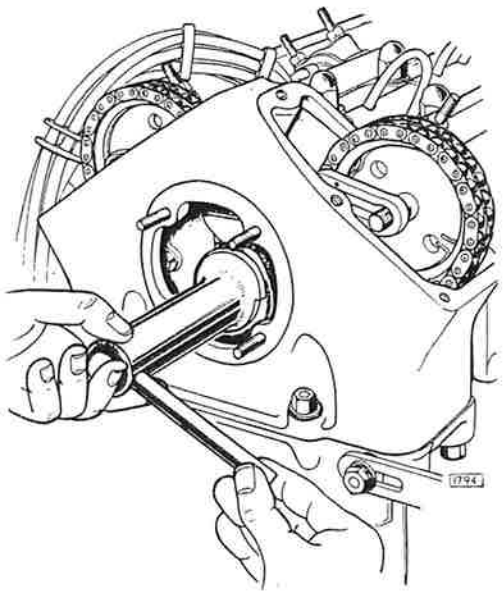


Fig. 12. Adjusting the top timing chain.

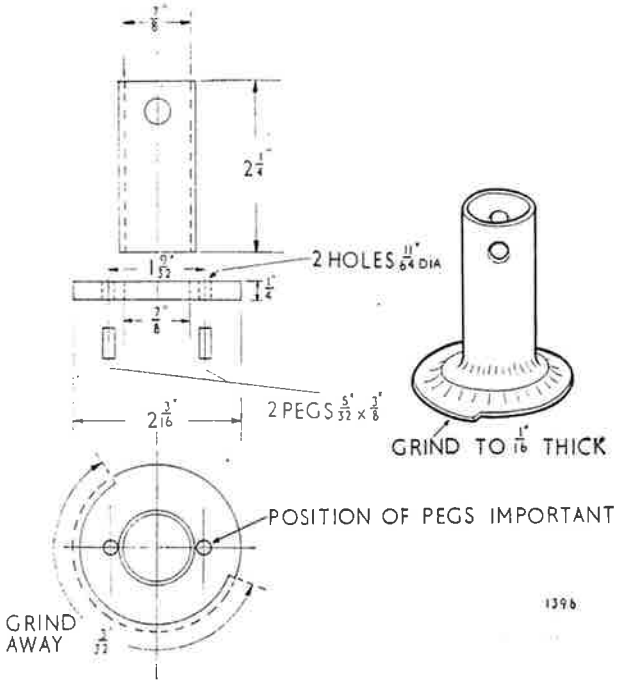


Fig. 13. The top timing chain adjusting tool.

once disconnected the camshaft sprockets do NOT rotate the engine or camshafts.

Slacken the fourteen cylinder head dome nuts and six nuts securing the front of the cylinder head a part of a turn at a time in the order shown in Fig. 18 until the nuts become free. Lift off the cylinder head complete with exhaust manifold and inlet manifolds. Remove and scrap the cylinder head gasket.

REMOVE CLUTCH AND FLYWHEEL

Unscrew the six setscrews securing the flange of the clutch cover to the flywheel and remove the clutch assembly. Note the balance marks 'B' stamped on the clutch cover and on the edge of the flywheel.

Knock back the tabs of locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

REMOVE CRANKSHAFT DAMPER

Unscrew the large nut and remove the plain washer.

Insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

REMOVE WATER PUMP

Unscrew the set bolts and three nuts, and remove the water pump from the timing cover. Note the gasket between the pump and timing cover.

REMOVE OIL FILTER

Detach the short length of flexible pipe between the oil filter head and the oil sump.

Unscrew the four set bolts securing the oil filter head to the cylinder block and remove filter head.

REMOVE SUMP

Drain the sump by removing the hexagon plug and washer from the right-hand side of the sump.

Remove the twenty-six setscrews securing the sump to the crankcase and the four nuts securing the sump to the timing cover. The sump can now be removed.

REMOVE OIL PUMP AND PIPES

Tap back the tab washers and unscrew the two set bolts securing the oil feed pipe from the oil pump to the bottom face of the crankcase. Withdraw the pipe from the pump.

Remove the nut and bolt securing the oil pump inlet pipe clip to the bracket on the main bearing cap.

Remove the nut and bolt securing the oil pump inlet pipe clip in the bracket on the oil pump.

Withdraw the pipe from the pump.

Tap back the tab washers and unscrew the three bolts securing the oil pump to the front main bearing cap. The oil pump can now be withdrawn.

Remove the coupling shaft from the squared end of the distributor and oil pump drive shaft.

REMOVE PISTONS AND CONNECTING RODS

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Remove the split pins from the connecting rod bolt nuts and unscrew nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are together.

Withdraw the piston and connecting rod from top of cylinder block.

Note: Split skirt pistons MUST be fitted with the split opposite to the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the pistons crowns are marked "Front".

REMOVE TIMING COVER

Remove the set bolts securing the timing cover to the front face of the cylinder block. Remove the timing cover, noting that the cover is located to the cylinder block by two dowels.

REMOVE TIMING GEAR ASSEMBLY

When removing the bottom timing chain tensioner from the engine, remove the hexagon head plug and tab washer from the end of the body. Insert an Allen key into the hole until it registers in the end of the restraint cylinder. Turn the Allen key clockwise until the restraint cylinder can be felt to be fully retracted within the body. The adjuster head will then be free of the chain.

Knock back the tab washers on the two set bolts. securing the chain tensioner to the cylinder block.

Withdraw the bolts and remove the tensioner together with the conical gauze filter fitted in the tensioner oil feed hole in the cylinder block this should be cleaned in petrol.

Unscrew the four set bolts securing the front mounting bracket to the cylinder block. Release the tabs of the tab washers and remove the two screwdriver slotted setscrews from the rear mounting

bracket; these setscrews also secure the intermediate timing chain damper bracket.

The timing gear can now be removed.

REMOVE DISTRIBUTOR DRIVE GEAR

Tap back the tab washer securing the distributor drive gear nut and remove the nut and washer. Tap the squared end of the distributor drive shaft through the gear, noting that the gear is keyed to the shaft. Remove the gear and thrust washer and withdraw the drive shaft.

REMOVE CRANKSHAFT

Knock back the tab washers securing the fourteen main bearing cap bolts. Unscrew the bolts and remove the main bearing caps, noting the corresponding numbers stamped on the caps and bottom face of crankcase and also the thrust washers fitted to the recesses in the centre main bearing caps.

Detach the bottom half of the oil return thread cover from the top half by unscrewing the two Allen screws. Note that the two halves are located by hollow dowels.

The crankshaft can now be lifted out from the crankcase.

ENGINE—TO ASSEMBLE

GENERAL

All references in this section to the top or bottom of the engine assume the engine to be upright, irrespective of the position of the unit when the reference is made. References to the left- or right-hand side assume the engine to be upright and looking from the rear.

FIT DISTRIBUTOR DRIVE SHAFT BUSH

If a new bush is to be fitted, press the bush into the bore of the lug at front of cylinder block.

Ream the bush in position to a diameter of $\frac{3}{4}''^{+\cdot0005''}_{-\cdot00025''}$ (19·05 mm. $^{+\cdot012\text{ mm.}}_{-\cdot006\text{ mm.}}$)

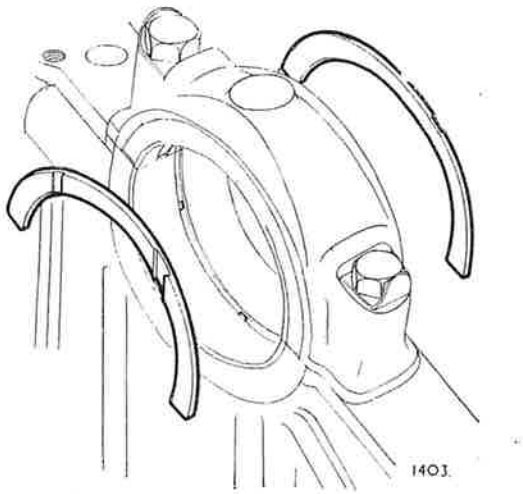


Fig. 14. The crankshaft thrust washers.

FIT CRANKSHAFT

Fit the main bearing shells to the top half of the main line bore in the cylinder block. Lay the crankshaft in the bearing shells. Fit the bottom half of the oil return thread cover to the top half which is bolted to the cylinder block behind the rear main bearing. The two halves are located by hollow dowels and secured with Allen screws. The clearance between the oil return thread cover and the oil return thread on the crankshaft should be ·0025″ to ·0055″ (·06 to ·14 mm.).

The two halves of the oil return thread cover are supplied only as an assembly together with the dowels and screws.

Fit the centre main bearing cap with a thrust washer, white metal side outward, to the recess in each side of cap. Tighten down the cap and check the crankshaft end float, which should be ·004″ to ·006″ (·10 to ·15 mm.). The thrust washers are supplied in two thicknesses, standard and ·004″ (·10 mm.) oversize and should be selected to bring the end float within permissible limits. The oversize thrust washers are stamped +·004″ (·10 mm.) on the steel face.

Fit the main bearing caps with the numbers stamped on the caps with the corresponding numbers stamped on the bottom face of the crankcase.

Fit the main bearing cap bolts and tab washers and tighten to a torque of 83 lb.ft. (11·5 kgm.).

Test the crankshaft for free rotation.

The tab washers for the rear main bearing bolts are longer than the remainder and the plain ends should be tapped down around the bolt hole bosses.

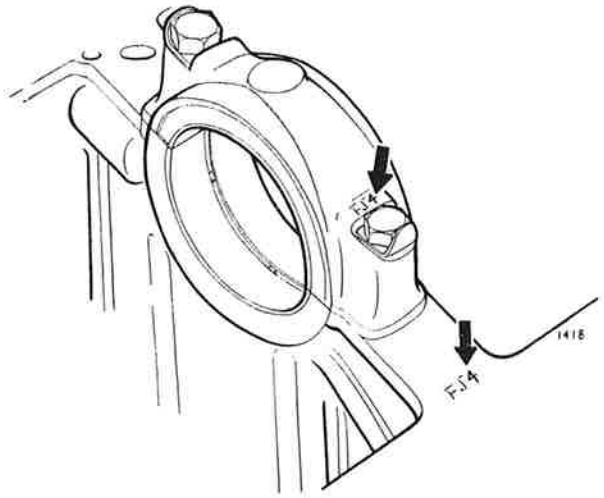


Fig. 15. Showing the corresponding numbers marked on the main bearing cap and the crankcase.

FIT PISTONS AND CONNECTING RODS

Turn the engine on its side. Remove the connecting rod caps and fit the pistons and connecting rods to their respective bores from the top of the cylinder block, using a suitable piston ring compressor. The cylinder number is stamped on the connecting rod and cap, No. 1 cylinder being at rear.

Note: Semi-split skirt pistons MUST be fitted with the split opposite the thrust side, that is, with the split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked "Front".

Fit the connecting rod caps to the connecting rods with the corresponding numbers together. Fit the castellated nuts and tighten to a torque of 37 lb.ft. (5·1 kgm.). Secure nut with split pins.

FIT CRANKSHAFT GEAR AND SPROCKET

Fit the Woodruff key to the inner slot and tap the distributor crankshaft gear into position with the widest part of the boss to the rear (see Fig. 25).

Fit the Woodruff key to the outer slot and tap the crankshaft timing gear sprocket into position. Fit the oil thrower and distance piece.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C.

FIT DISTRIBUTOR AND OIL PUMP DRIVE GEAR

Ensure that the Woodruff key on the distributor drive shaft is in good condition and renew if necessary.

Place the drive shaft into position with the offset slot in the top of the shaft as shown in Fig. 16.

Withdraw the shaft slightly maintaining the same slot position and place the thrust washer and drive gear on the end of the shaft. Press the shaft into the drive gear ensuring that the key engages the keyway correctly.

Fit the pegged tab washer with the peg in the keyway of the drive gear.

Fully tighten the nut and secure with the tab washer. Check the end float of the shaft which should be ·004" to ·006" (·10 to ·15 mm.).

If no clearance exists fit a new oil pump/distributor drive gear which will restore the clearance. In an emergency if a new drive gear is not available, the thrust washer may be reduced in thickness by rubbing down on a piece of emery cloth placed on a surface plate.

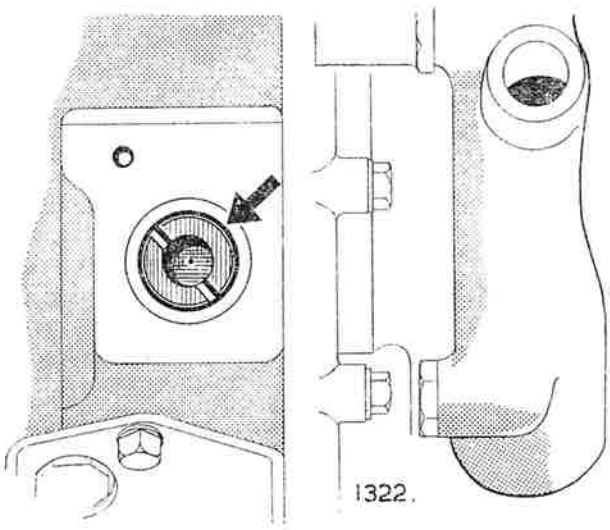


Fig. 16. Showing the position of the distributor drive shaft offset when No. 6 (front) piston is on Top Dead Centre.

FIT OIL PUMP AND PIPES

Fit the coupling shaft between the squared end of the distributor drive shaft and the driving gear of the oil pump. Secure the oil pump to the front main bearing cap by the three dowel bolts and tab washers. Check that there is appreciable end-float of the short coupling shaft. Fit the oil delivery pipe from the oil pump to the bottom face of the crankcase with a new 'O' ring and gasket. Fit the suction pipe with a new 'O' ring at the oil pump end.

TO ASSEMBLE TIMING GEAR

Fit the eccentric shaft to the hole in front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket. Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.

Fit the two intermediate sprockets (20 and 28 teeth) to their shaft with the larger sprocket forward and press the shaft through lower central hole in rear mounting bracket. Secure with the circlip at the rear of the bracket.

Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (shorter chain) to the large intermediate sprocket.

Loop upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

Fit the intermediate damper to the bottom of the rear mounting bracket with two screwdriver slotted setscrews and tab washers.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets together with four stud nuts and shakeproof washers.

FIT TIMING GEAR

Turn the engine upside down. Fit the lower timing chain damper and bracket to the front face of the cylinder block with two set bolts and locking plate.

Turn the timing gear assembly upside down and offer it up to the cylinder block. Loop the bottom timing chain over the crankshaft sprocket and secure the mounting brackets to the front face of the cylinder block with the four long securing bolts and the two screwdriver slotted setscrews which also secure the intermediate timing chain damper bracket, but do not fully tighten these two setscrews until the four long securing bolts are tight.

TIMING CHAIN TENSIONER

Place the timing chain tensioner, backing plate and filter in position so that the spigot on the tensioner aligns with the hole in the cylinder block. Fit shims, as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper. Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine WITH THE TIMING CHAIN IN POSITION.

Remove the hexagon head plug and tab washer from the end of the body. Insert the Allen key into the hole until it registers in the end of the retraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure with the tab washer.

FIT TIMING COVER

Fit the circular oil seal to the recess in the bottom face of timing cover, ensuring that seal is well bedded in its groove.

Fit the timing cover gasket with good quality jointing compound and secure the timing cover to the front face of the cylinder block with securing bolts.

FIT OIL SUMP

Fit a new sump gasket to the bottom face of the crankcase. Fit the cork seal to the recess in the rear main bearing cap.

Fit the sump to the crankcase and secure with the twenty-six set screws, four nuts and washers.

Note: The short setscrew must be fitted to the right-hand front corner of the sump (Fig. 39).

FIT FLYWHEEL AND CLUTCH

Turn the engine upright.

Check that the crankshaft flange and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so that the 'B' stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark 'B' on the flywheel is

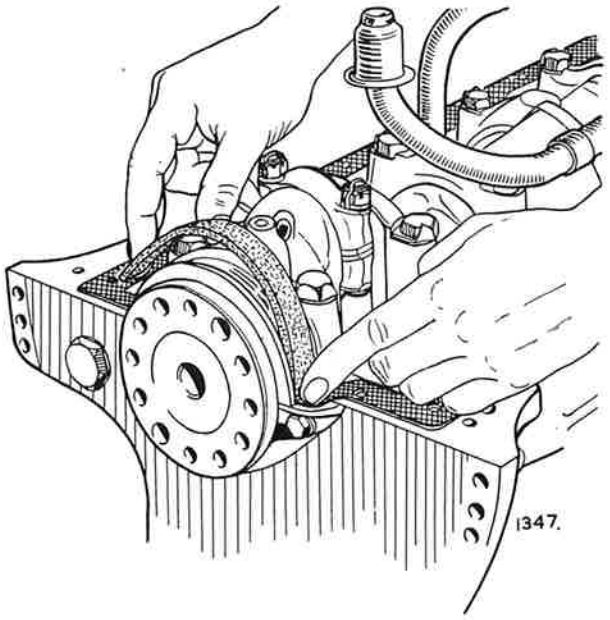


Fig. 17. Fitting the rear oil seal.

in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

Tap the two mushroom-headed dowels into position, fit the locking plate and flywheel securing set screws. Tighten the set screws to a torque of 67 lbs. ft. (9·2 kgm.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, noting that one side of the plate is marked "Flywheel Side". Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose). Fit clutch cover assembly so that the 'B' stamped adjacent to one of the dowel holes coincides with the 'B' stamped on the periphery of the flywheel. Secure the clutch assembly with the six set screws and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

FIT CYLINDER HEAD

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere

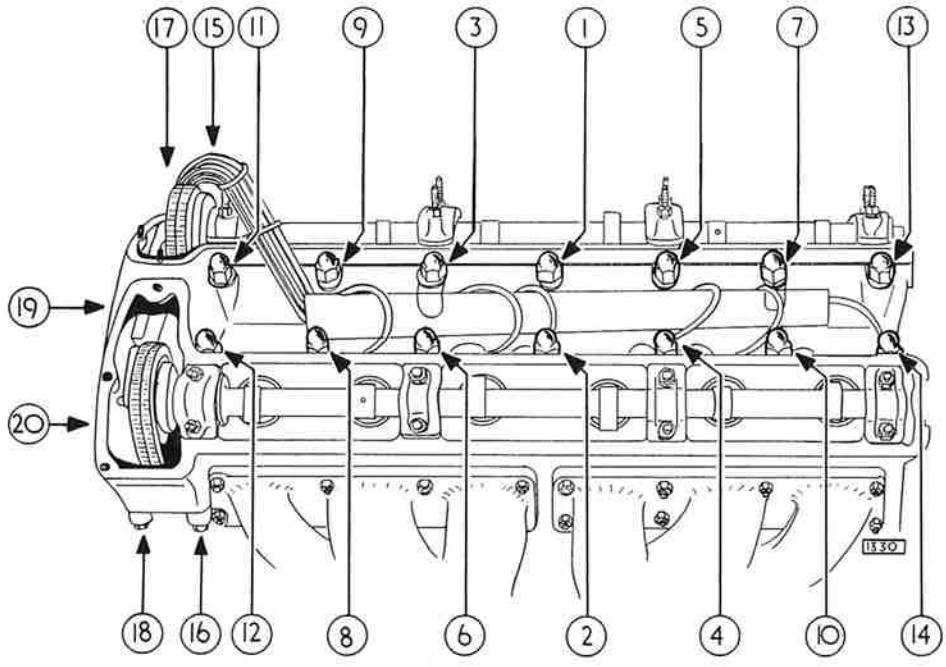


Fig. 18. Tightening sequence for the cylinder head nuts.

to the following procedure before fitting the cylinder head:—

Check that the grooves in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the top dead centre position with the widest portion of the distributor drive shaft offset positioned as shown in Fig. 16.

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts. Fit the two camshaft sprockets complete with adjuster plates and circlips to the top timing chain and enter the guide pins in the slots in the front mounting bracket.

Fit the cylinder head gasket, taking care that the side marked "Top" is uppermost. Fit the cylinder head complete with manifolds to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud on the right-hand side. Fit plain washers to these and the two front stud positions and 'D' washers to the remaining studs. Tighten the fourteen large cylinder head dome nuts a part of a turn at a time to a torque of 54 lb.ft. (7·5 kgm.) in the order shown in Fig. 18. Also tighten the six nuts securing the front end of the cylinder head.

VALVE TIMING

Check that the No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the lock nut securing the serrated plate.

With the camshaft sprocket on the flanges of the camshafts, tension chain by pressing locking plunger inwards and rotating serrated plate by the two holes in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is the chain must not be dead tight. Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshaft with the valve timing gauge, and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the setscrews are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and timing in this order. Secure the four setscrews retaining the camshaft sprockets with new lock wire.

FIT CYLINDER HEAD OIL FEED PIPE AND OIL FILTER

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a copper washer fitted to both sides of each banjo.

Fit the oil filter head to the cylinder block with the four setscrews and copper washers. New gasket(s) must always be fitted between the filter and cylinder block.

Fit the short length of flexible hose between the oil filter head and the oil sump and tighten two hose clips.

FIT CRANKSHAFT DAMPER AND PULLEY

Fit a Woodruff key to the crankshaft and the split cone. Fit the split cone to the crankshaft with the widest end towards the timing cover. Fit the damper to the cone and secure with the flat washer, chamfered side outwards, and large bolt.

FIT WATER PUMP

Fit the water pump to the timing cover with a new gasket and secure with six bolts, three nuts and spring washers.

FIT DYNAMO AND WATER PUMP BELT

Slacken the setscrew securing the dynamo adjusting link to the timing cover and swing link upwards.

Fit the dynamo belt to the crankshaft and water pump pulleys. Offer up dynamo and engage dynamo belt with pulley. Secure dynamo with the two mounting bolts and adjusting link at the water pump. Before finally tightening, adjust dynamo belt tension by pulling dynamo outwards until the belt can be flexed approximately ½" (12 mm.) either way in the middle of the vertical run. Tighten the adjusting setscrew, the two dynamo mounting bolts and the bolt securing the adjusting link to the water pump.

Note: Undue tension will create heavy wear of belt, pulleys, water pump and dynamo bearings.

FIT DISTRIBUTOR AND SPARKING PLUGS

Fit the cork seal to the recess at the top of the hole for the distributor. Secure the distributor clamping plate to the cylinder block with the setscrew. Slacken the clamping plate bolt.

Set the micrometer adjustment in the centre of the scale.

Enter the distributor into the cylinder block with the vacuum advance unit connection facing the cylinder block.

Rotate the rotor-arm until the driving dog engages with the distributor drive shaft.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap. (Fig. 19).

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Slowly rotate the distributor body until the points are just breaking.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

Fit the vacuum advance pipe from the distributor to the union on the front carburetter.

Fit the distributor cover and secure with the two spring clips. Fit the sparking plugs with new washers and attach high tension leads.

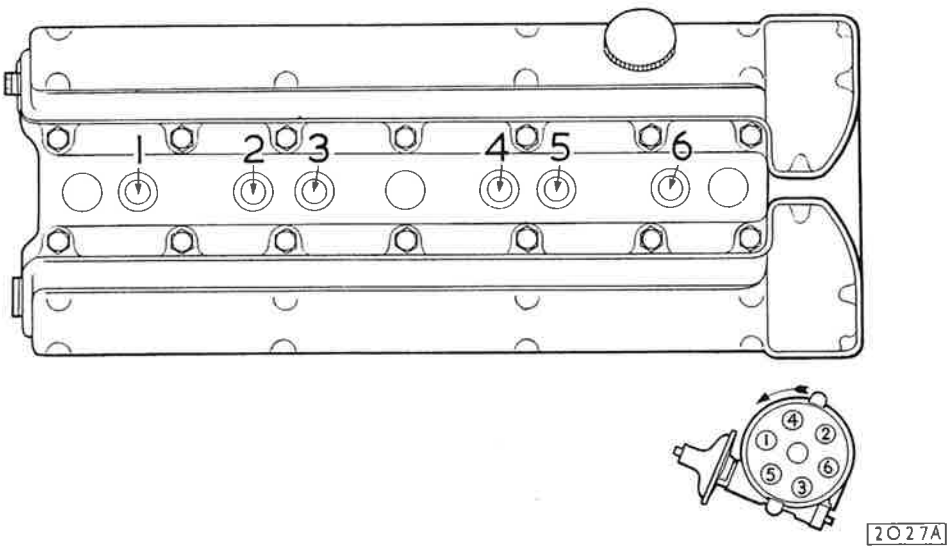


Fig. 19. View of the engine showing the firing order and cylinder numbers.

HIGH TENSION LEAD RENEWAL

If it is necessary to renew the high tension leads the following procedure should be followed:—

Remove the plug terminals and withdraw the leads from the conduit.

Remove the distributor cap terminals and the five spacing washers.

Cut the new high tension leads to suitable length.

Fit the leads to the conduit, No. 1 lead emerges from the rear of the conduit and the other leads from holes along the conduit.

Fit the plug terminals.

Fit the two thick fibre washers, arranging the leads in firing order (that is, 1, 5, 3, 6, 2, 4) in an anti-clockwise order, as the leads will enter the distributor cap.

Fit the three thin fibre spacers and place them equally along the leads.

Fit the distributor cap terminals.

FIT CAMSHAFT COVERS

Fit each camshaft cover to the cylinder head using a new gasket. Fit the eleven copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter generator and flanged plug to the rear of right-hand and left-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided. Secure with the setscrews and copper washers. Tighten fully the dome nuts securing the camshaft covers.

FIT STARTER

Fit the starter motor to the clutch housing with the two bolts, nuts and spring washers.

FIT GEARBOX

Fit the gearbox and clutch housing to the rear of the crankcase with setscrews and shakeproof washers.

Fit the support brackets to each side, at the bottom face of the crankcase with two bolts, nuts and spring washers, and to the clutch housing with three bolts, nuts and shakeproof washers.

DECARBONISING AND GRINDING VALVES

REMOVE CYLINDER HEAD

Remove the cylinder head as described on page B.41.

REMOVE VALVES

With the cylinder head on the bench remove the inlet manifold, and the revolution counter generator.

Remove the four bearing caps from each camshaft and lift out the camshaft (note mating marks on each bearing cap).

Remove the twelve tappets and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in their original locations, No. 1 cylinder being at the rear, that is the flywheel end.

DECARBONISE AND GRIND VALVES

Remove all traces of carbon and deposits from the combustion chambers from the induction and exhaust ports. The cylinder head is of aluminium alloy and great care should be exercised not to damage this with scrapers or sharp pointed tools. Use worn emery cloth and paraffin only. Thoroughly clean the water passages in the cylinder head. Clean the carbon deposits from the piston crowns and ensure that the top face of the cylinder block is quite clean particularly round the cylinder head studs. Remove any pitting in the valve seats, using valve seat grinding equipment. Reface the valves if necessary using valve grinding equipment; grind the valves to the seats, using a suction valve grinding tool.

Clean the sparking plugs and set gaps; if possible use approved plug cleaning and testing equipment. Clean and adjust distributor contact breaker points.

VALVE CLEARANCE ADJUSTMENT

Thoroughly clean all traces of valve grinding compound from the cylinder head and valve gear.

Assemble the valves to the cylinder head. **When checking the valve clearances the camshafts must be fitted one at a time as if one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.**

Correct valve clearances are:—

Normal Touring Use

Inlet	·004″ (·10 mm.).
Exhaust	·006″ (·15 mm.).

Racing

Inlet	·006″ (·15 mm.).
Exhaust	·010″ (·25 mm.).

Adjusting pads are available rising in ·001″ (·03 mm.) sizes from ·085″ to ·110″ (2·16 to 2·79 mm.) and are etched on the surface with the letter 'A' to 'Z', each letter indicating an increase in size of ·001″ (·03 mm.). Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the existing adjusting pad if visible. If the letter is not visible measure the pad with a micrometer, and should the recorded clearance for this valve have shown say ·002″ (·05 mm.) excessive clearance, select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as ·007″ (·18 mm.). On removal of the adjusting pad, if this is etched with the letter 'D' then substitution with a pad bearing the letter 'G' will correct the clearance for No. 1 inlet valve.

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face (using valve timing gauge) before tightening down the camshaft bearing cap nuts.

Tighten the camshaft bearing cap nuts to a torque of 15 lb.ft. (2·0 kgm.).

REFIT CYLINDER HEAD

Before attempting to refit the cylinder head refer to the instructions given on page B.42.

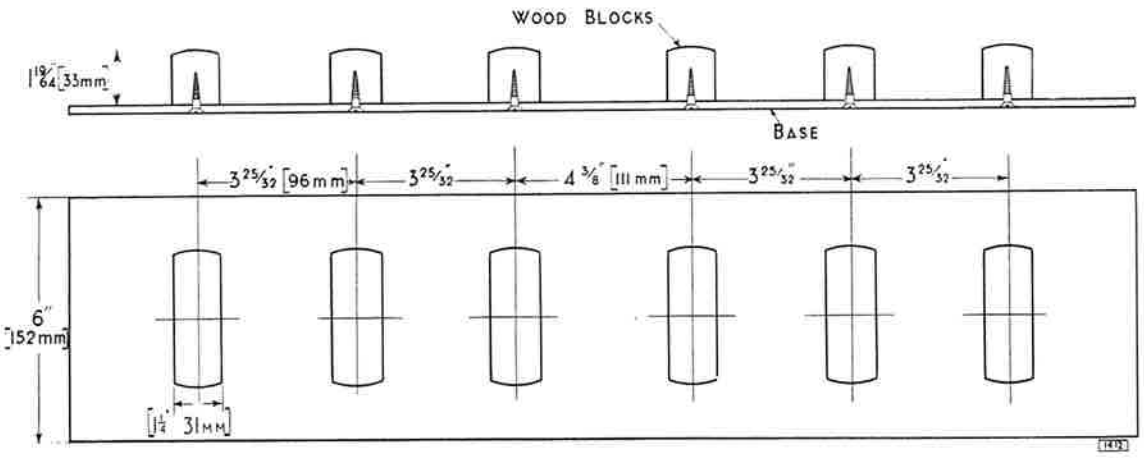


Fig. 20. Combustion chamber blocks for valve removal.

COMPRESSION PRESSURES

The compression pressures for all the six cylinders should be even and should approximate to the figures given below.

If one or more compressions are weak it will most probably be due to poor valve seatings when the cylinder head must be removed and the valves and valve seats refaced and reground.

COMPRESSION PRESSURES

8 to 1 compression ratio: 155 lbs per sq. in. (10·90 kg/cm²).

9 to 1 compression ratio: 180 lbs per sq. in. (12·65 kg/cm²).

Pressures must be taken with all the sparking plugs removed, carburetter throttles wide open and the engine at its normal operating temperature (70°C approximately).

Note: When taking compression pressures ensure that the ignition switch is 'off'; rotate the engine by operating the push button on the starter solenoid.

THE CONNECTING ROD AND BEARINGS

The connecting rods are steel stampings and are provided with precision shell big-end bearings and steel backed phosphor-bronze small end bushes. A longitudinal drilling through the connecting rod provides an oil feed from the big end to the small end bush.

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top.

Proceed as follows:—

Remove Cylinder Head

Remove the cylinder head as described on page B.41.

Remove Sump

Remove the sump as described on page B.50.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of the cylinder block.

OVERHAUL

If connecting rods have been in use for a very high mileage, or if bearing failure has been experienced, it is desirable to renew the rod(s) owing to the possibility of fatigue.

The connecting rods fitted to an engine should not vary one with another by more than 2 drams (3·5 grammes). The alignment should be checked on an approved connecting rod alignment jig. Correct any misalignment as necessary. The big end bearings are of the precision shell type and under no circumstances should they be hand scraped or the bearing caps filed.

The small ends are fitted with steel-backed phosphor-bronze bushes which are a press fit in the connecting rod. After fitting, the bush should be reamed or honed to a diameter of ·875″ to ·8752″ (22·225 to 22·23 mm.). Always use new connecting bolts and nuts at overhauls.

When a new connecting rod is to be fitted, although the small end bush is reamed to the correct dimensions, it may be necessary to hone the bush to achieve the correct gudgeon pin fit.

REFITTING

Refitting is the reverse of the removal procedure. Pistons and connecting rods must be fitted to their respective cylinders (pistons and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.

The pistons must be fitted with split on the left-hand or exhaust side of the engine. To facilitate

correct fitting the piston crowns are marked "Front", see Fig. 42.

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.

Tighten the connecting rod nuts to a torque of 37 lb.ft. (5·1 kgm.).

BIG-END BEARING REPLACEMENT

The big-end bearings can be replaced without removing the engine from the car but before fitting the new bearings the crankpin must be examined for damage or for the transfer of bearing metal. The oilway in the crankshaft must also be tested for blockage.

Remove the sump as described on page B.50.

Turn the engine until the big-end is approximately at the bottom dead centre position.

Remove the split pins from the connecting rod bolt nuts and unscrew the nuts. Remove the connecting rod cap, noting that the corresponding cylinder numbers on the connecting rod and cap are on the same side.

Lift the connecting rod off the crankpin and detach the bearing shell.

If all the big-end bearings are to be replaced they are most easily replaced in pairs, that is, in pairs of connecting rods having corresponding crank throws.

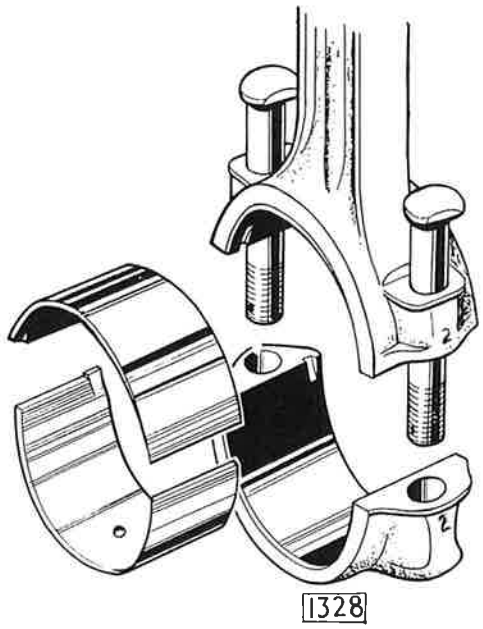


Fig. 21. The connecting rod and cap are stamped with the cylinder number.

THE CAMSHAFTS

The camshafts are manufactured of cast iron and each shaft is supported in four white metal steel backed bearings. End float is taken on the flanges formed at each side of the front bearing. Oil is fed from the main oil gallery to the camshaft rear bearing housings through an external pipe. Oil then passes through the rear bearing into a longitudinal drilling in the camshaft; cross drillings which break into this oilway feed the three remaining bearings.

Warning: Before carrying out any work on the camshafts the following points must be observed to avoid possible fouling between (a) the inlet and exhaust valves and (b) the valves and pistons.

(1) Do NOT rotate the engine or the camshafts with the camshafts sprockets disconnected. If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

(2) When fitting the camshafts to the cylinder head ensure that keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face (use valve timing gauge) before tightening down the camshaft bearing cap nuts.

If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

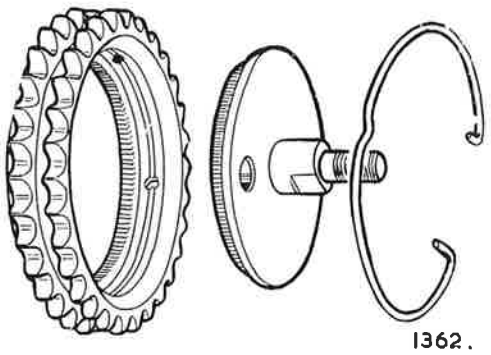


Fig 22. Exploded view of the camshaft sprocket assembly.

REMOVAL

Remove the eleven dome nuts and copper washers securing each camshaft cover and lift off the cover.

Unscrew the three Allen setscrews attaching the revolution counter generator to the right-hand side of the cylinder head and the sealing plug from the left-hand side (note the copper washers under the heads of the setscrew). Remove the circular rubber sealing rings.

Break the wire locking the camshaft adjuster plate setscrews.

Rotate the engine until No. 6 (front) piston is approximately on Top Dead Centre on compression stroke (firing position), that is, when the keyway in the front bearing flange of each camshaft is at 10° to the adjacent cover face (see Fig. 23).

Note the positions of the **inaccessible** adjuster plate setscrews and rotate the engine until they can be removed.

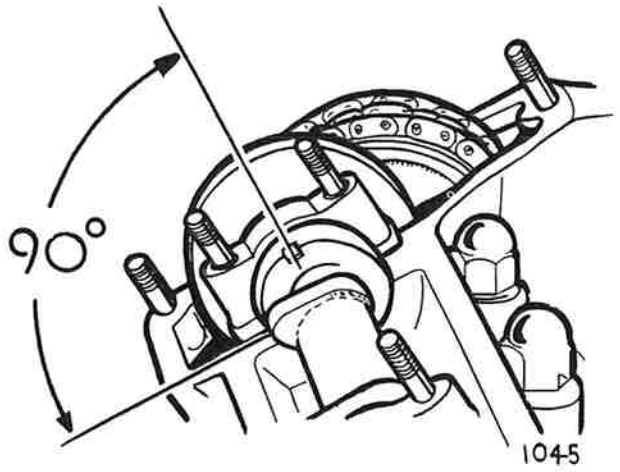


Fig. 23. When fitting a camshaft the keyway must be at 90° to the camshaft cover face.

Turn back the engine to the T.D.C. position with No. 6 firing and remove the two remaining setscrews.

Tap the sprockets off their respective camshaft flanges. Release the eight nuts securing the bearing caps a turn at a time. Remove the nuts, spring washers and 'D' washers from the bearing studs.

Remove the bearing caps, noting that the caps and cylinder head are marked with corresponding numbers. Also note that the bearing caps are located to the lower bearing housings with hollow dowels.

If the same bearing shells are to be replaced they should be fitted to their original positions.

The camshaft can now be lifted out from the cylinder head.

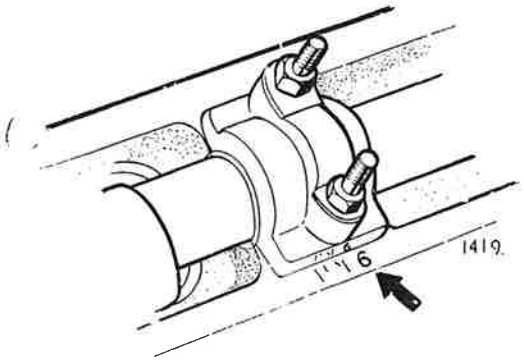


Fig. 24. Showing the corresponding numbers on the bearing cap and cylinder head.

REFITTING

Check that No. 6 (front) piston is exactly on T.D.C. on the compression stroke (firing position), that is, with the distributor rotor opposite No. 6 cylinder segment. (Fig. 19).

Replace the shell bearings—in their original positions if the same bearings are being refitted.

Replace each camshaft with the keyways in the front bearing flange at 90° to the adjacent cover face (using the valve timing gauge).

Refit the bearing caps to their respective positions and the 'D' washers, spring washers and nuts.

Tighten down the bearing caps evenly a turn at a time. Finally tighten the nuts to a torque of 15 lb.ft. (2·0 kgm.).

Set the valve timing as described on page B.63.

OVERHAUL

It is unlikely, except after very high mileages, to find wear in the camshafts and camshaft bearings. The camshaft bearings are of the precision shell type and under no circumstances should these be hand scraped or the bearing caps filed. Undersize bearings are not supplied.

THE CRANKSHAFT

The counterbalanced crankshaft is of manganese molybdenum steel and is supported in seven precision shell bearings. End thrust of the crankshaft is taken on two semi-circular white metal faced steel thrust washers fitted in recesses in the centre main bearing cap. A torsional vibration damper is fitted at the front end of the crankshaft.

Initially, the crankshaft is itself balanced both statically and dynamically and is then re-balanced as an assembly with the flywheel and clutch unit attached.

REMOVAL

Proceed as detailed under "Engine—To Dismantle" on page B.21.

OVERHAUL

Regrinding of the crankshaft journals is generally recommended when wear or ovality in excess of ·003″ (·08 mm.) is found. Factory reconditioned crankshafts are available on an exchange basis, subject to the existing crankshaft being fit for satisfactory reconditioning, with undersize main and big end bearings —·010″ (·25 mm.), —·020″ (·51 mm.), —·030″ (·76 mm.), and —·040″ (1·02 mm.).

Grinding beyond the limits of ·040″ (1·02 mm.) is not recommended and under such circumstances a new crankshaft should be obtained.

New crankshaft thrust washers should be fitted, these being in two halves located in recesses in the centre main bearing cap. Fit the main bearing cap with a thrust washer, white metal side outwards, to the recess in each side of the cap. Tighten down the cap and check the crankshaft end float, which should be ·004″ to ·006″ (·10 to ·15 mm.). The thrust washers are supplied in two thicknesses, standard and ·004″ (·10 mm.) oversize and should be selected to bring the end float within the required limits. It is permissible to fit a standard size thrust washer to one side of the main bearing cap and an oversize washer to the other. Oversize thrust washers are stamped ·004″ on the steel face.

Ensure that the oil passages in the crankshaft are clear and perfectly clean before re-assembling. If the original crankshaft is to be refitted remove the Allen headed plugs in the webs (which are secured by staking) and thoroughly clean out any accumulated sludge with a high pressure jet followed by blowing out with compressed air.

After refitting the plugs, secure by staking with a blunt chisel.

REFITTING

Proceed as detailed under "Engine—To Assemble" on page B.23.

CRANKSHAFT DAMPER AND PULLEY

A torsional vibration damper is fitted at the front end of the crankshaft.

The damper consists of a malleable iron ring bonded to a thick rubber disc. An inner member also bonded to the disc is attached to a hub which is keyed to a split cone on the front extension of the crankshaft.

The crankshaft damper and pulley are balanced as an assembly, mark each part before dismantling so that they can be refitted in their original positions.

REMOVAL

It will be necessary to remove the crankshaft damper from beneath the car.

Remove the dynamo and water pump belt by slackening the dynamo and moving it towards the engine.

Remove the locking washer securing the damper bolt by knocking back the tabs and unscrewing the two setscrews. Remove the other two setscrews securing the crankshaft pulley to the damper and remove the pulley.

Unscrew the large damper securing bolt and remove the flat washer.

Insert two levers behind the damper and ease it off the split cone—a sharp tap on the end of the cone will assist removal.

OVERHAUL

Examine the rubber portion of the damper for signs of deterioration and if necessary fit a new one. Also examine the crankshaft pulley for signs of wear and renew if necessary. The drive should be taken on the 'V' faces of the pulley; renew the pulley if a new fan belt bottoms in the 'V' groove.

REFITTING

Refitting is the reverse of the removal procedure.

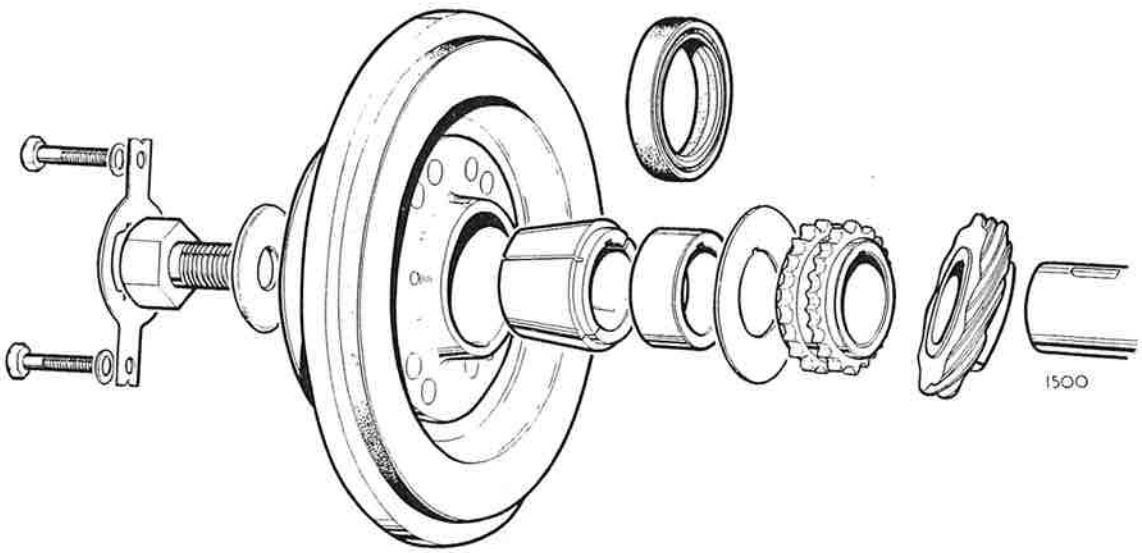


Fig. 25. The crankshaft damper and components.

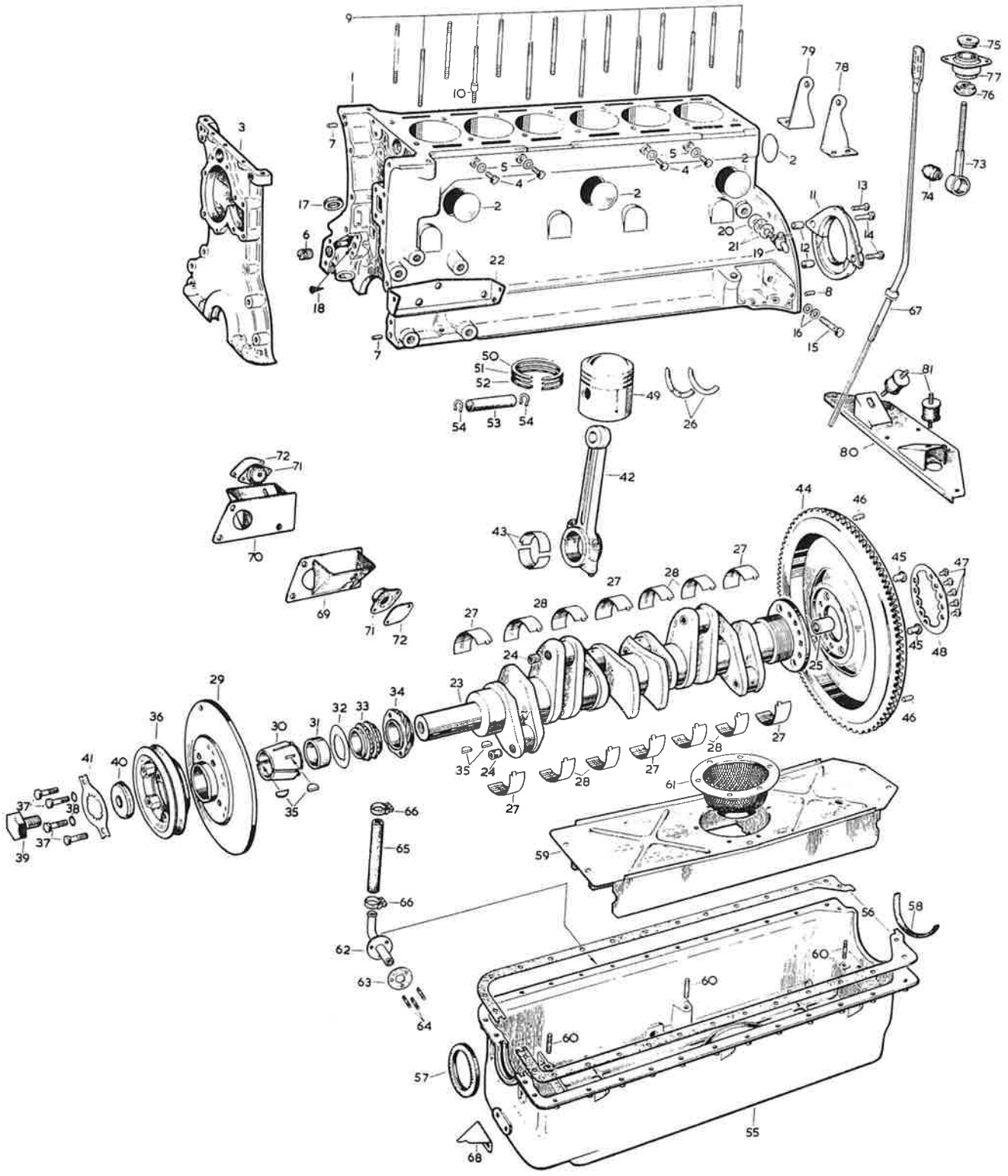


Fig. 26. Exploded view of the cylinder block assembly.

1. Cylinder block
2. Core plug
3. Timing cover
4. Setscrew
5. Copper washer
6. Plug
7. Dowel
8. Dowel
9. Stud
10. Dowel stud
11. Cover
12. Ring dowel
13. Setscrew
14. Bolt
15. Banjo bolt
16. Copper washer
17. Sealing ring
18. Gauze filter
19. Drain tap
20. Copper washer
21. Fibre washer
22. Mounting bracket
23. Crankshaft
24. Plug
25. Bush
26. Thrust washer
27. Main bearing
28. Main bearing
29. Crankshaft damper
30. Cone
31. Distance piece
32. Oil thrower
33. Sprocket
34. Gear
35. Key
36. Pulley
37. Bolt
38. Locking washer
39. Bolt
40. Washer
41. Tab washer
42. Connecting rod
43. Bearings
44. Flywheel
45. Dowel
46. Dowel
47. Setscrew
48. Locking plate
49. Piston
50. Compression ring
51. Compression ring
52. Scraper ring
53. Gudgeon pin
54. Circlip
55. Oil sump
56. Gasket
57. Seal
58. Cork seal
59. Baffle plate
60. Stud
61. Filter basket
62. Adaptor
63. Gasket
64. Stud
65. Hose
66. Clip
67. Dipstick
68. Pointer
69. Bracket
70. Bracket
71. Engine mounting
72. Plate
73. Link
74. Bush
75. Stepped washer
76. Stepped washer
77. Rubber mounting
78. Bracket
79. Bracket
80. Support bracket
81. Rubber mounting

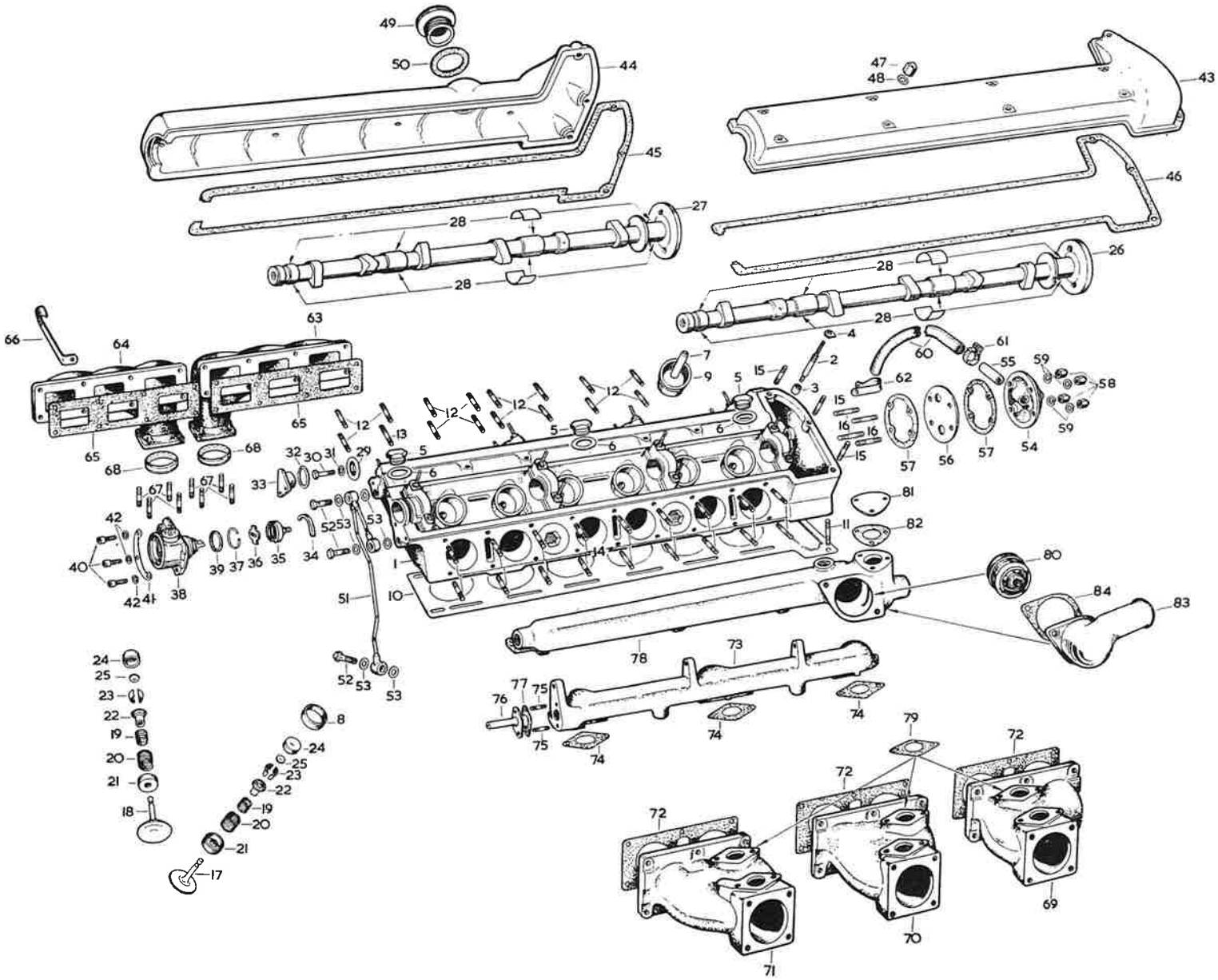


Fig. 27. Exploded view of the cylinder head assembly.

1. Cylinder head
2. Stud
3. Ring dowel
4. 'D' washer
5. Plug
6. Copper washer
7. Valve guide
8. Valve insert
9. Tappet guide
10. Gasket
11. Stud
12. Stud
13. Stud
14. Stud
15. Stud
16. Stud
17. Inlet valve
18. Exhaust valve
19. Valve spring
20. Valve spring
21. Seat
22. Collar
23. Cotter
24. Tappet
25. Adjusting pad
26. Inlet camshaft
27. Exhaust camshaft
28. Bearing
29. Oil thrower
30. Setscrew
31. Copper washer
32. Sealing ring
33. Sealing plug
34. Seal
35. Adaptor
36. Driving dog
37. Circlip
38. Generator
39. Sealing ring
40. Screw
41. Plate washer
42. Lock washer
43. Inlet camshaft cover
44. Exhaust camshaft cover
45. Gasket
46. Gasket
47. Dome nut
48. Copper washer
49. Filler cap
50. Fibre washer
51. Oil pipe
52. Banjo bolt
53. Copper washer
54. Breather housing
55. Pipe
56. Baffle
57. Gasket
58. Dome nut
59. Spring washer
60. Flexible pipe
61. Clip
62. Clip
63. Exhaust manifold
64. Exhaust manifold
65. Gasket
66. Clip
67. Stud
68. Sealing ring
69. Inlet manifold
70. Inlet manifold
71. Inlet manifold
72. Gasket
73. Air balance pipe
74. Gasket
75. Stud
76. Adaptor
77. Gasket
78. Water pipe
79. Gasket
80. Thermostat
81. Plate
82. Gasket
83. Elbow
84. Gasket

THE CYLINDER BLOCK

The cylinder block is of chromium iron and is integral with the crankcase. The main bearing housings are line bored and the caps are not interchangeable, corresponding numbers being stamped on the caps and the bottom face of the crankcase for identification purposes. Pressed in dry liners are fitted.

OVERHAUL

Check the top face of the cylinder block for truth. Check that the main bearing caps have not been filed and that the bores for the main bearings are in alignment. If the caps have been filed or if there is misalignment of the bearing housings the caps must be re-machined and the bearing housings line bored.

After removal of the cylinder head studs prior to reboring, check the area around the stud holes for flatness. When the edges of the stud holes are found to be raised they must be skimmed flush with the surrounding joint face, to ensure a dead flat surface on which to mount the boring equipment.

Reboring is normally recommended when the bore wear exceeds ·006″ (·15 mm.). Reboring beyond the limit of ·030″ (·76 mm.) is not recommended and when the bores will not clean out at ·030″ (·76 mm.), liners and standard size pistons should be fitted.

The worn liners must be pressed out from below utilizing the illustrated stepped block.

Before fitting the new liner, lightly smear the cylinder walls with jointing compound to a point half way down the bore and also smear the top outer surface of the liner.

Press the new liners in from the top and lightly skim the tops of the liners flush with the top face of the cylinder block.

Bore out and hone the liners to suit the grade (or grades) of pistons to be fitted. (See piston grades on page B.52).

The following oversize pistons are available: + ·010″ (·25 mm.), + ·020″ (·51 mm.) and + ·030″ (·76 mm.).

Following reboring the blanking plugs in the main oil gallery should be removed and the cylinder block oilways and the crankcase interior thoroughly cleaned. After cleaning, paint the crankcase interior with heat and oil resisting paint.

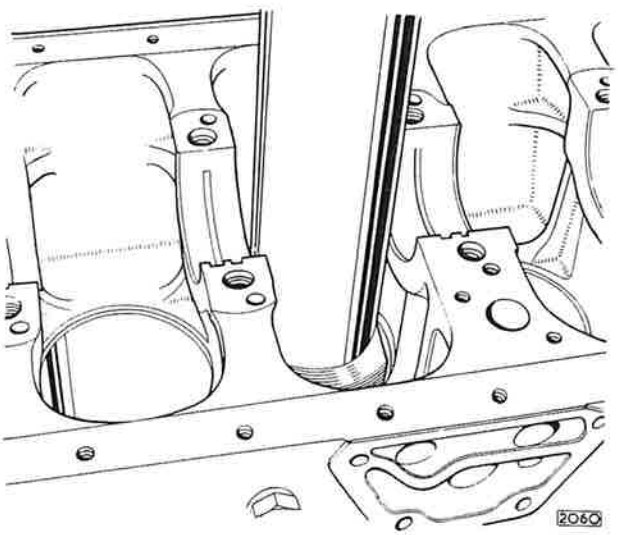


Fig. 28. Removing a cylinder liner.

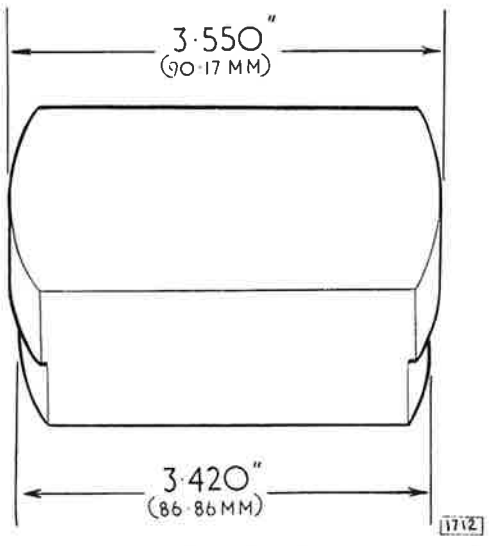


Fig. 29. Stepped block for cylinder liner removal.

THE CYLINDER HEAD

The cylinder head is manufactured of aluminium alloy and has machined hemispherical combustion chambers. Cast iron valve seat inserts, tappet guides and valve guides are shrunk into the cylinder head castings.

Warning: Before carrying out any work on the cylinder head the following points should be observed to avoid possible fouling between (a) the inlet and exhaust valves, and (b) the valves and pistons.

(1) Do NOT rotate the engine or the camshafts with the camshaft sprockets disconnected. If, with the cylinder head removed from the engine, it is required to rotate a camshaft, the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

(2) When fitting the camshafts to the cylinder head ensure that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts. If this operation is being carried out with the cylinder head fitted to the engine, rotate the engine until No. 6 (front) piston is on Top Dead Centre in the firing position, that is with the distributor rotor opposite No. 6 cylinder segment, before fitting the camshafts.

Note: As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface; support the cylinder head on wooden blocks, one at each end.

REMOVAL

Remove the bonnet (as described in Section N "Body").

Drain the cooling system by turning the radiator drain tap, opening the cylinder block drain tap and removing the header tank filler cap.

Conserve the coolant if anti-freeze is in use.

Disconnect the battery.

Remove the wing nuts and remove the air cleaner elbow from the top of the air cleaner.

Disconnect the accelerator shaft from the ball joint on the throttle spindle.

Remove the setscrews from the backing plate and from the bush carrying plate.

Ensure that the push-in cage nuts do not fall out of the bulkhead.

Turn the throttle spindle to the fully open position and remove the short spindle from the ball joint socket.

Disconnect the distributor vacuum advance pipe from the front carburetter.

Disconnect the petrol feed pipe at the float chamber unions.

Remove the clip attaching the overflow pipes from the float chambers to the oil filter mounting bolt.

Disconnect the mixture control inner and outer cable.

Disconnect the cables from the revolution counter generator at the rear of the cylinder head.

Disconnect the top water hose and by-pass hose from the front of the inlet manifold water jacket.

Remove the high tension leads from the sparking plugs and the lead carrier from the cylinder head studs.

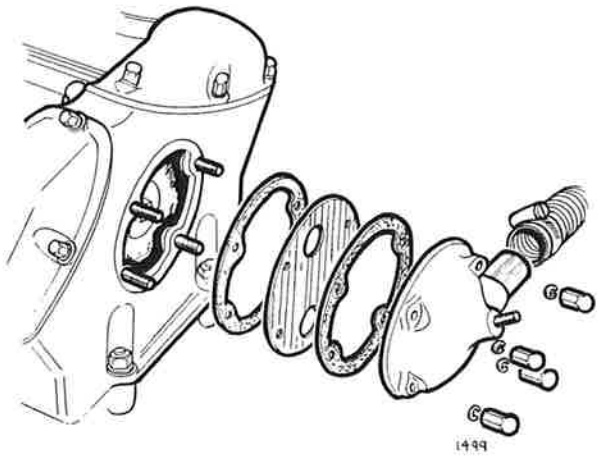


Fig. 30. Removal of the engine breather.

Disconnect the wires from the ignition coil and remove the coil.

Remove the sparking plugs.

Disconnect the exhaust manifolds from the engine.

Disconnect the two camshaft oil feed pipe unions from the rear of the cylinder head.

Disconnect the heater box from the rear of the inlet manifold water jacket.

Disconnect the heater pipe clips from the inlet manifold lower securing nuts.

Disconnect the cable from the water temperature gauge bulb in the inlet manifold water jacket.

Slacken the clip and remove the vacuum servo pipe from the connection at the rear of the inlet manifold.

Remove the eleven dome nuts from each camshaft cover and lift off the covers.

Remove the four nuts securing the breather housing to the front of the cylinder head and withdraw the housing and breather pipe observing the position of the baffle plate with the two holes vertical.

Release the tension on the top timing chain by slackening the nut on the eccentric idler sprocket shaft, depressing the spring-loaded stop peg and rotating the serrated adjuster plate clockwise.

Break the locking wire on the two setscrews securing the camshaft sprocket to the respective camshafts.

Remove one setscrew only from each of the camshaft sprockets; rotate the engine until the two remaining setscrews are accessible and remove these two screws.

Do NOT rotate the engine or the camshafts after having disconnected the sprockets.

The two camshaft sprockets may now be slid up the support brackets.

Slacken the fourteen cylinder head dome nuts a part of a turn at a time in the order shown (Fig. 18) until the nuts become free. Remove the six nuts securing the front of the cylinder head.

Lift off the cylinder head complete with inlet manifolds. Remove and scrap the cylinder head gasket.

OVERHAUL

As the cylinder head is of aluminium alloy, great care should be exercised when carrying out overhaul work, not to damage or score the machined surfaces. When removing carbon do not use scrapers or sharply pointed tools—use worn emery cloth and paraffin only.

Check the bottom face of the cylinder head for truth.

Remove all traces of carbon and deposits from the combustion chambers and the inlet and exhaust ports and regrind the valve and seats if necessary, as described under "Decarbonising and Grinding Valves" on page B.29.

If it is required to replace the valve guides, valve seat inserts or tappet guides, only the special replacement parts must be used. The replacement parts must be shrunk into the cylinder head in accordance with the instructions given under the appropriate headings in this section.

REFITTING

Fit Cylinder Head

Before refitting the cylinder head it is important to observe that if the camshafts are out of phase with piston position fouling may take place between the valves and pistons. It is, therefore, essential to adhere to the following procedure before fitting the cylinder head:—

Check that the keyways in the front flanges of the camshafts are vertical to the camshaft housing face and accurately position by engaging the valve timing gauge. If it is found necessary to rotate one of the camshafts the other camshaft must either be removed or the bearing cap nuts slackened to their fullest extent to allow the valves to be released.

Turn No. 6 (front) piston to the Top Dead Centre position with the distributor rotor arm opposite No. 6 cylinder segment. (Fig. 19).

Do NOT rotate the engine or camshafts until the camshaft sprockets have been connected to the camshafts.

Fit the cylinder head gasket, taking care that the side marked "Top" is uppermost. Fit the cylinder head complete with manifolds to the cylinder block. Note that the second cylinder head stud from the front on the left-hand side is a dowel stud.

Fit the sparking plug lead carrier to the 3rd and 6th stud from the front on the right-hand side. Fit plain washers to these and the two front stud positions. Fit 'D' washers to the remaining studs.

Tighten the fourteen large cylinder head dome nuts a part of a turn at a time to a torque of 54 lb.ft. (7·5 kgm.) in the order shown in Fig. 18. Also tighten the six nuts securing the front end of the cylinder head.

Valve Timing

Check that No. 6 (front) piston is exactly in the T.D.C. position.

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate.

With the camshaft sprocket on the flanges of the camshafts, tension chain by pressing locking plunger inwards and rotating serrated plate by two holes in an anti-clockwise direction.

When correctly tensioned there should be slight flexibility on both outer sides of the chain below the camshaft sprockets, that is, the chain must not be

dead tight. Release the locking plunger and securely tighten the locknut. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshafts with the valve timing gauge and check that the T.D.C. marks are in exact alignment.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and pull the adjusting plates forward until the serrations disengage. Replace the sprockets on to the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the set-screws are fitted the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly, the adjuster plates should be turned through 180°, which, due to the construction of the plate, will facilitate alignment.

Fit the circlips to the sprockets and one setscrew to the accessible hole in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews retaining the camshaft sprockets with new locking wire.

Fit Cylinder Head Oil feed Pipe

Fit the cylinder head oil feed pipe from the tapped hole in the main oil gallery to the two tapped holes in the rear of the cylinder head. Secure the pipe with the three banjo bolts with a new copper washer fitted to both sides of each banjo.

Fit Camshaft Covers

Fit each camshaft cover to the cylinder head using a new gasket. Fit the eleven copper washers and dome nuts to the cover retaining studs but do not tighten fully.

Fit the revolution counter generator and flanged plug to the rear of left-hand and right-hand camshaft covers respectively with the rubber sealing rings seated in the recesses provided and secure with the setscrews and copper washers. Tighten fully the dome nuts securing the camshaft covers.

Note on Refitting

When refitting the throttle linkage, note that the backing plate is offset and ensure that the backing plate assembly is aligned correctly before tightening up.

The remainder of the re-assembly is the reverse of the removal procedure.

THE EXHAUST MANIFOLDS

REMOVAL

Remove the eight brass nuts and spring washers securing the exhaust pipe flanges to the exhaust manifolds.

Remove the sixteen brass nuts and spring washers securing the exhaust manifolds to the cylinder head when the manifolds can be detached.

REFITTING

Refitting is the reverse of the removal procedure. Use new gaskets between the manifolds and the cylinder head and new sealing rings between the exhaust pipe and manifold flanges.

THE FLYWHEEL

The flywheel is a steel forging and has integral starter gear teeth. The flywheel is located to the crankshaft by two mushroom-headed dowels and is secured by ten setscrews retained by a circular locking plate

REMOVAL

Remove the engine as described on page B.19. Unscrew the four setscrews and remove the cover plate from the front face of the clutch housing.

Remove the bolts and nuts securing the clutch

housing to the engine and withdraw the gearbox unit.

Unscrew the six setscrews securing the flange of clutch cover to the flywheel and remove clutch assembly. Note the balance marks 'B' stamped on the clutch cover and on the periphery of the flywheel.

Knock back the tabs of locking plate securing the ten flywheel bolts. Unscrew the flywheel bolts and remove the locking plate. Remove flywheel from the crankshaft flange by gently tapping with a rawhide mallet.

OVERHAUL

If the starter gear is badly worn a new flywheel should be used, since the starter gear teeth are integral with the flywheel, and in this case it will be necessary to balance the flywheel and clutch as an assembly.

If a new flywheel is being fitted, check the flywheel and clutch balance as an assembly by mounting on a mandrel and setting up on parallel knife edges. Mark the relative position of clutch and flywheel. If necessary, remove the clutch and drill $\frac{3}{8}$" (9·5 mm.) balance holes not more than $\frac{1}{2}$" (12·7 mm.) deep at a distance of $\frac{3}{8}$" (9·5 mm.) from the edge of the flywheel.

REFITTING

Turn the engine upright.

Check that the crankshaft flange and the holes for the flywheel bolts and dowels are free from burrs.

Turn the engine until Nos. 1 and 6 pistons are on T.D.C. and fit the flywheel to the crankshaft flange so that the 'B' stamped on the edge of the flywheel is at approximately the B.D.C. position. (This will ensure that the balance mark 'B' on the flywheel is in line with the balance mark on the crankshaft which is a group of letters stamped on the crank throw just forward of the rear main journal).

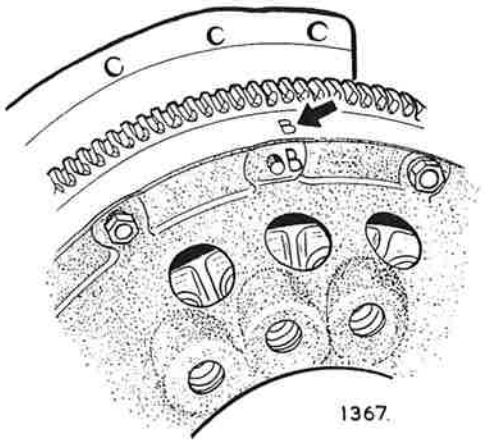


Fig. 31. Showing the balance marks 'B' on the clutch and flywheel.

Tap the two mushroom-headed dowels into position, fit the locking plate and flywheel securing setscrews. Tighten the setscrews to a torque of 67 lb.ft. (9·2 kgm.) and secure with the locking plate tabs. Assemble the clutch driven plate to the flywheel, noting that one side of the plate is marked "Flywheel Side". Centralise the driven plate by means of a dummy shaft which fits the splined bore of the driven plate and the spigot bush in the crankshaft. (A constant pinion shaft may be used for this purpose). Fit clutch cover assembly so that the 'B' stamped adjacent to one of the dowel holes coincides with the 'B' stamped on the periphery of the flywheel. Secure the clutch assembly with the six setscrews and spring washers, tightening the screws a turn at a time by diagonal selection. Remove the dummy shaft.

IGNITION TIMING

Set the micrometer adjustment in the centre of the scale.

Rotate the engine until the rotor-arm approaches the No. 6 (front) cylinder segment in the distributor cap. (Fig. 19).

Slowly rotate the engine until the ignition timing scale on the crankshaft damper is the appropriate number of degrees before the pointer on the sump.

Ignition Settings

Connect a 12 volt test lamp with one lead to the distributor terminal (or the CB terminal of the ignition coil) and the other to a good earth.

Slacken the distributor plate pinch bolt.

Switch on the ignition.

Slowly rotate the distributor body until the points are just breaking, that is, when the lamp lights up with the fibre heel leading the appropriate cam lobe in the normal direction of rotation.

Tighten the distributor plate pinch bolt.

A maximum of six clicks on the vernier adjustment from this setting, to either advance or retard, is allowed.

Static Ignition Timing

8 to 1 compression ratio	..	9° B.T.D.C.
9 to 1 compression ratio	..	10° B.T.D.C.

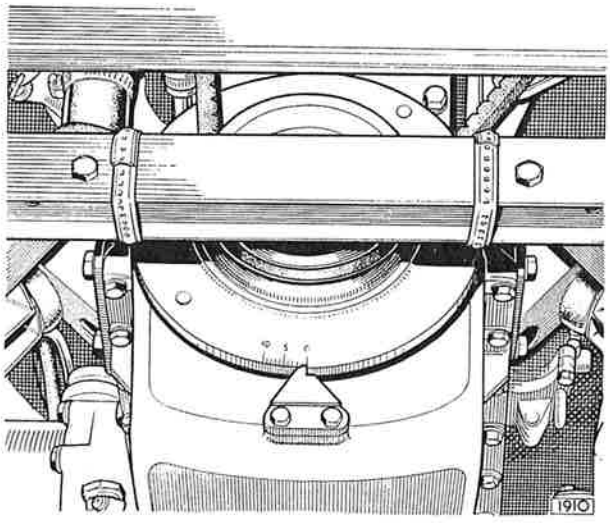


Fig. 32. Showing the timing scale marked on the crankshaft damper. The scale is marked in crankshaft degrees from 0° (top dead centre) to 10° advance (before top dead centre).

THE INLET MANIFOLD

The inlet manifold is in three separate aluminium castings each feeding two cylinders. They are water heated by the coolant from the cylinder head through cast in passages. A water outlet pipe attached to the inlet manifold houses the thermostat and has the top water hose and by-pass hose connected at the front end.

REMOVAL

Drain the radiator.

Remove the carburetters (as described in Section C "Carburetters and Fuel System").

Slacken the clips and disconnect the top water hose and by-pass hoses from the inlet manifold water outlet pipe.

Disconnect the cable to the temperature gauge indicator unit.

Disconnect the heater hose from the connection at the rear of the manifold.

Disconnect the servo pipe from the connection at the rear of the manifold.

Disconnect the accelerator shaft from the ball joint on the throttle spindle.

Remove the setscrews from the backing plate and bush carrying plate.

Ensure that push-in cage nuts do not fall out of the bulkhead. Turn the throttle spindle to the fully open position and remove the short spindle from the ball joint socket.

Remove the eighteen nuts and spring washers, detach the heater pipe clips from the lower studs when the inlet manifold can be withdrawn. Remove six nuts and spring washers and the water manifold. Remove six nuts and spring washers and the air balance pipe.

REFITTING

Refitting is the reverse of the removal procedure. It should be noted that when refitting the throttle linkage ensure that the backing plate is fitted with the cage nuts for the bush carrying plate offset towards the engine—ensure that the backing plate assembly is aligned correctly before tightening up.

THE OIL FILTER

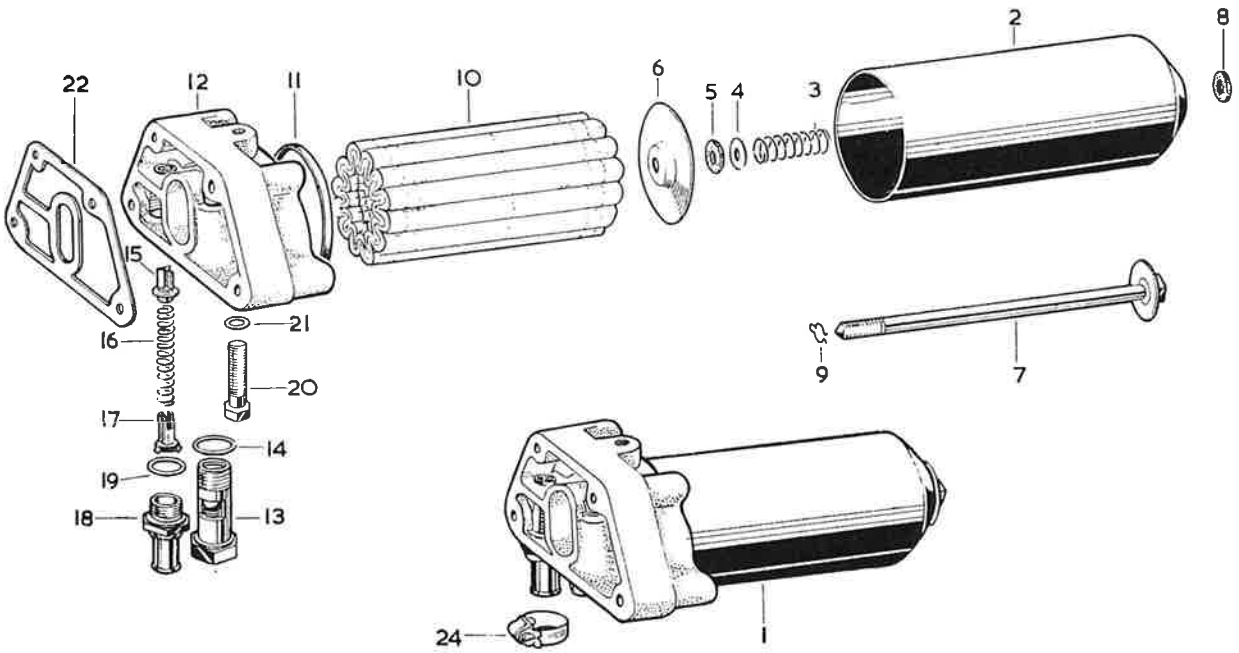
The oil filter is of the full flow type and has a renewable element. The oil from the oil pressure relief valve is returned to the engine sump by an external rubber hose. The oil pressure relief valve is retained by the outlet adaptor to which the hose to the sump is secured.

A balance valve fitted in the filter head opens at a pressure differential of 10 to 15 lbs. per sq. in. (0·7 to 1·1 kg./cm.^{2}) provides a safeguard against the possibility of the filter element becoming so choked that oil is prevented from reaching the bearings.

REMOVAL OF THE OIL FILTER

When removing the oil filter it is advisable to catch any escaping oil.

Remove the splash tray from below the brake vacuum reservoir. Remove the cable to the oil pressure transmitter unit in the oil filter head. Slacken the clip and



1. Oil filter complete
2. Canister
3. Spring
4. Washer
5. Felt washer
6. Pressure plate
7. Bolt
8. Washer
9. Spring clip
10. Element
11. Sealing ring
12. Filter head
13. Balance valve
14. Washer
15. Relief valve
16. Spring
17. Spider and pin
18. Adaptor
19. Washer
20. Drain plug
21. Washer
22. Gasket
23. Hose
24. Clip

Fig. 33. Exploded view of oil filter.

remove the rubber hose from below the filter head.

Detach the oil filter assembly from the side face of the cylinder block by removing the four bolts and withdraw the assembly from beneath the car. Collect the gasket fitted between the filter head and the cylinder block.

REFITTING THE OIL FILTER

Refitting is the reverse of the removal procedure but a new gasket must be fitted between the oil filter head and the cylinder block.

ELEMENT REPLACEMENT

It is most important to renew the oil filter element at the recommended periods as after this mileage it will have become choked with impurities.

To guard against the possibility of the filter being neglected to the extent where the element becomes completely choked, a balance valve is incorporated in the filter head which allows unfiltered oil to by-pass the element and reach the bearings. This will be accompanied by a drop in the normal oil pressure of some 10 lbs. per sq. in and if this occurs the filter element should be renewed as soon as possible.

The oil filter is situated at the right-hand side of the engine and it is advisable when removing the filter canister, to catch any escaping oil. Unscrew the centre bolt and remove the canister and element from beneath the car retaining the rubber sealing ring. Empty out the oil, thoroughly wash out the canister with petrol and allow to dry before inserting a new element.

When refitting the canister, inspect the rubber sealing ring and renew it if necessary. Ensure that the ring is seating correctly in the groove between the canister and the filter head before tightening the centre bolt.

THE OIL PUMP

The oil pump is of the eccentric rotor type and consists of five main parts:— the body, the driving spindle with the inner rotor pinned to it, the outer rotor and the cover, which is secured to the main body by four bolts, finally being secured to the engine with additional dowel bolts. The inner rotor has one lobe less than the number of internal segments in the outer rotor. The spindle centre is eccentric to that of the bore in which the outer rotor is located, thus the inner rotor is able to rotate within the outer, and causes the outer rotor to revolve. The inlet connection is positioned in the pump cover, and the outlet connection in the body. These are both connected to the ports in the pump.

Consider the oil flow with the lobes of the inner rotor lying along the line of eccentricity. In this position oil is free to flow from the port into the space (dotted portion) between the rotors, and on the other side of the lobe (shaded portion) the oil is free to flow into the delivery port (see Fig. 34).

In the second position, the inner and outer rotors have rotated and caused the oil that was flowing from the inlet port into the space between them to be cut off from the port and transferred to the enclosed space

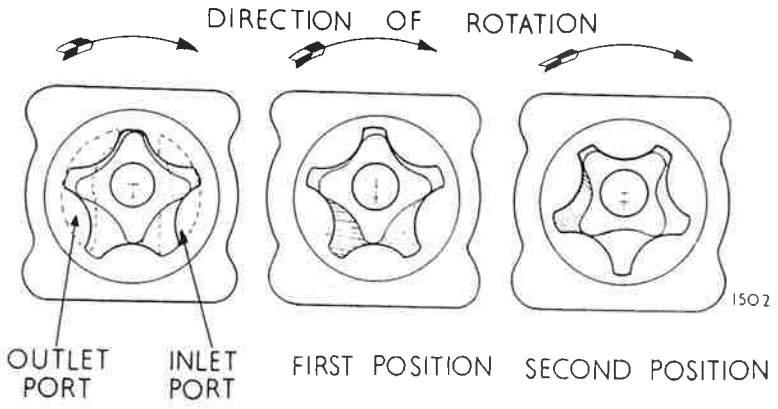


Fig. 34. Operation of eccentric rotor type oil pump.

between the ports. Similarly, the space which enclosed oil free to flow to the delivery port in the first position has decreased in size in the second position, and thus caused this oil to flow into the delivery port. The action of the pump is then a repetition of the above, oil flowing into the space between the rotors from the inlet port under atmospheric pressure and being discharged into the delivery port by reason of the space in which it is contained decreasing in size as it passes over the port.

REMOVAL

Remove the sump as described on page B.50.

Detach the suction and delivery pipe brackets and withdraw the pipes from the oil pump.

Tap back the tab washers and remove the three bolts which secure the oil pump to the front main bearing cap.

Withdraw the oil pump and collect the coupling sleeve at the top of the drive shaft.

DISMANTLING

Unscrew the four bolts and detach the bottom cover from the oil pump.

Withdraw the inner and outer rotors from the oil pump body. The inner rotor is pinned to the drive shaft and must not be dismantled.

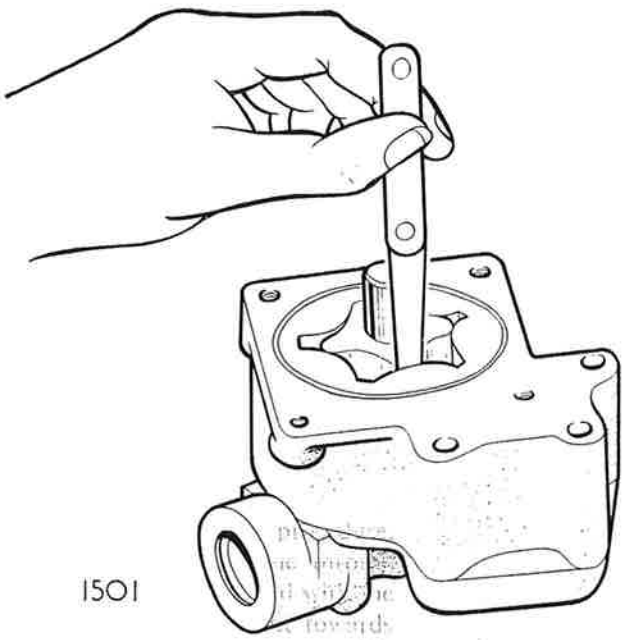


Fig. 35. Measuring the clearance between the inner and outer rotors.

OVERHAUL

Check the clearance between lobes of the inner and outer rotors which should be ·006″ (·15 mm.) maximum (see Fig. 35).

Check the clearance between the outer rotor and the pump body (see Fig. 36) which should not exceed ·010″ (·25 mm.).

Check the end-float of the rotors by placing a straight edge across the joint face of the body and measuring the clearance between the rotors and straight edge (see Fig. 37). This clearance should be ·0025″ (·06 mm.) and in an emergency can be restored by lapping the pump body and outer rotor on a surface plate to suit the inner rotor.

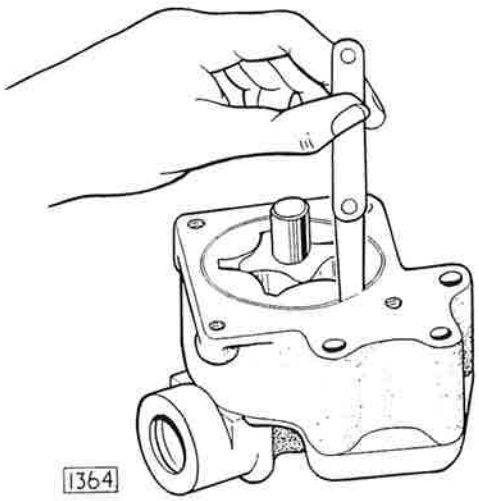


Fig. 36. Measuring the clearance between the outer rotor and the pump body.

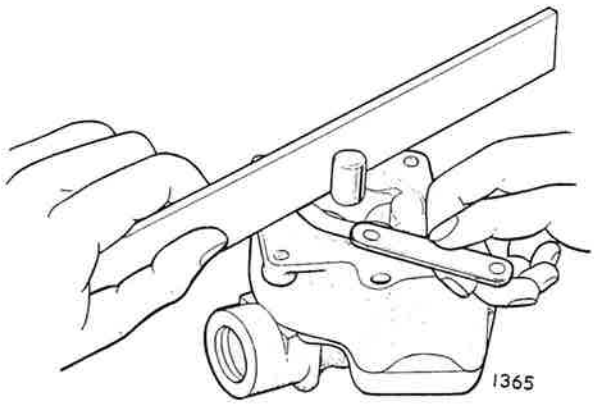


Fig. 37. Measuring the end float of the rotors.

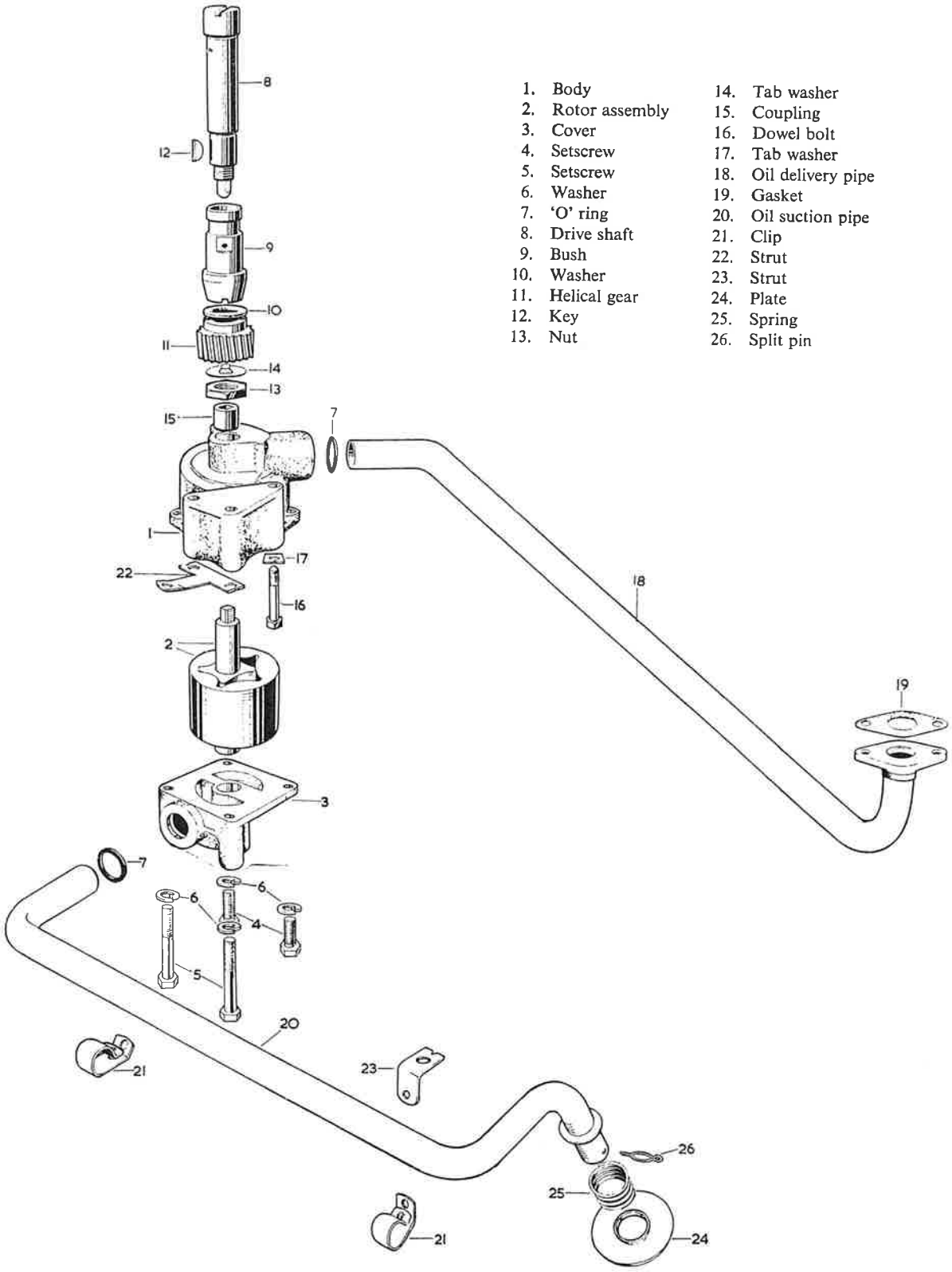


Fig. 38. Exploded view of the oil pump.

Examine the pump body and bottom cover for signs of scoring and the drive shaft bores for signs of wear; fit new parts as necessary.

Place the drive shaft in a vice fitted with soft jaws and check that the inner rotor is tight on the securing pin.

Note that the drive shaft, inner and outer rotors are supplied only as an assembly.

RE-ASSEMBLING

Re-assembly is the reverse of the dismantling procedure but it is important when fitting the outer rotor to the pump body to insert the chamfered end of the rotor foremost.

Always fit new "O" rings to the suction and delivery pipe bores.

REFITTING

Refitting is the reverse of the removal procedure.

Do not omit to fit the coupling sleeve to the squared end of the drive shaft before offering up the oil pump.

After fitting of the oil pump, check that there is appreciable end-float of the coupling sleeve.

OIL SUMP

All engine units are fitted with aluminium sumps which have an external connection for a rubber oil return hose the second end of which is attached to the oil filter head. A gauze bowl type filter is attached to the sump baffle plate.

REMOVAL

Remove the sump drain plug and drain the oil from the sump.

Remove the crankshaft damper.

Slacken the clip and disconnect the oil return hose at the oil filter head.

Unscrew the twenty-six setscrews and four nuts securing the sump. Remove the sump from the cylinder block noting that a short setscrew is fitted at the right-hand front corner of the sump as shown in Fig. 39.

Note: It may be necessary to slacken the engine stabiliser washers to allow the engine to be raised at the rear before the sump can be removed.

REFITTING

Scrape off all traces of old gaskets or sealing compound from the joint faces of the sump and crankcase.

Always fit new gaskets and rear oil seal when refitting the sump. If time permits, roll the rear oil seal into a coil and retain with string for a few hours. This will facilitate the fitting of the seal to its semi-circular recess.

Ensure that the short setscrew is fitted to the right hand front corner of the sump.

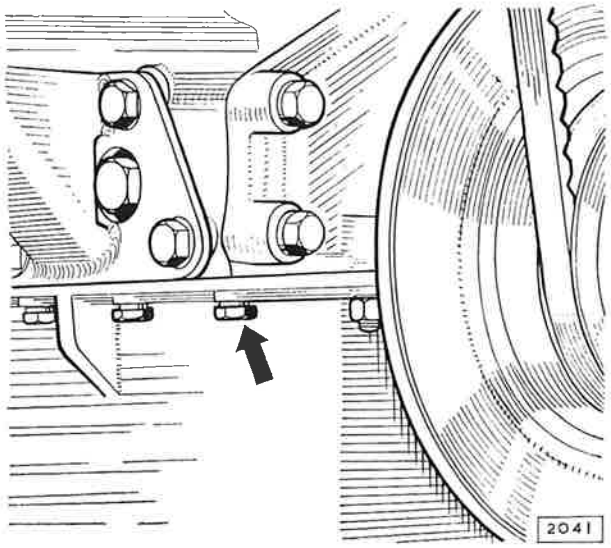


Fig. 39. Showing the location of the short setscrew.

PISTONS AND GUDGEON PINS

The pistons are made from low expansion aluminium alloy and are of the semi-split skirt type.

The pistons have three rings each, two compression and one oil control. The top compression ring only is chromium plated; both the top and second compression rings have a tapered periphery.

The fully floating gudgeon pin is retained in the piston by a circlip at each end.

ENGINE

REMOVAL

As the pistons will not pass the crankshaft it will be necessary to withdraw the pistons and connecting rods from the top. Proceed as follows:—

Remove Cylinder Head

Remove the cylinder head as described on page B.41.

Remove Sump

Remove the sump as described on page B.50.

Remove Piston and Connecting Rod

Remove the split pins from the connecting rod bolt nuts and unscrew nuts. Remove the connecting rod cap, noting the corresponding cylinder numbers on the connecting rod and cap. Remove the connecting rod bolts and withdraw the piston and connecting rod from the top of cylinder block.

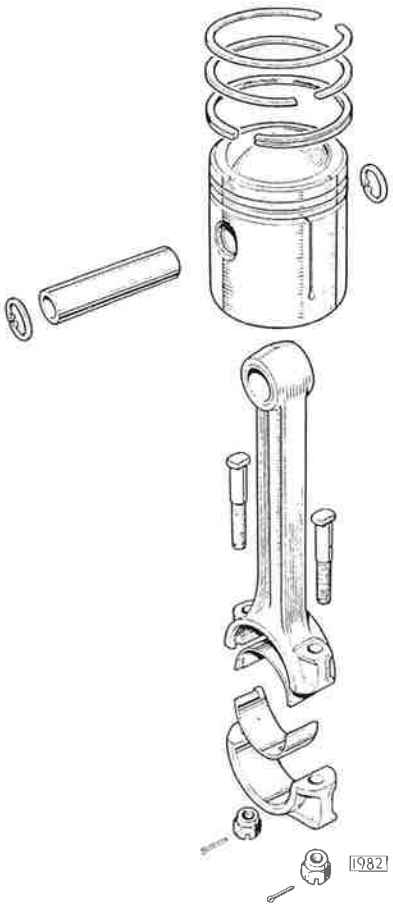


Fig. 40. Exploded view of the piston and connecting rod.

OVERHAUL

Pistons are supplied complete with gudgeon pins which have been selectively assembled and are, therefore, not interchangeable one with another.

The pistons fitted to an engine should not vary one with another by more than 2 drams (3·5 grammes).

Gudgeon Pin Fitting

Gudgeon pins are a finger push fit in the piston at normal room temperature 68°F (20°C).

When actually removing or refitting the gudgeon pin, the operation should be effected by immersing the piston, gudgeon pin and connecting rod little end in a bath of hot oil. When the piston and little end have reached a sufficient temperature (230°F. 110°C.) the gudgeon pin can be moved into position. Always use new circlips on assembly.

When assembling the engine, centralise the small end of the connecting rod between the gudgeon pin bosses in the piston and ensure that the connecting rod mates up with the crankshaft journal without any pressure being exerted on the rod.

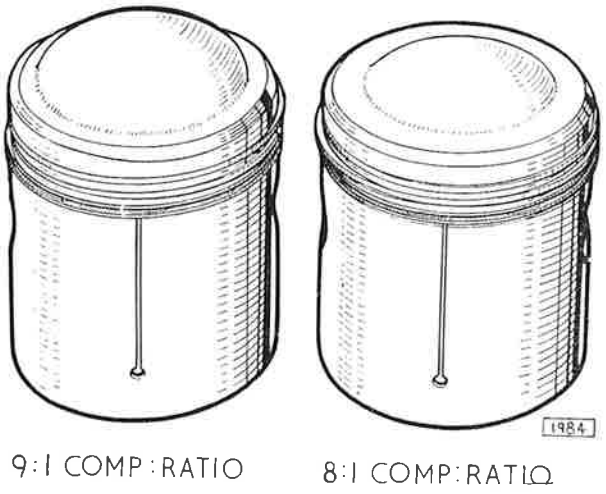


Fig. 41. 'E' type pistons.

Piston Grades

The following selective grades are available in standard size pistons only. When ordering standard size pistons the identification letter of the selective grade should be clearly stated. Pistons are stamped on the crown with the letter identification and the cylinder block is also stamped on the top face adjacent to the bores.

Grade Identification Letter	To suit cylinder bore size
F	3·4248″ to 3·4251″ (86·990 to 86·997 mm.)
G	3·4252″ to 3·4255″ (87·000 to 87·007 mm.)
H	3·4256″ to 3·4259″ (87·010 to 87·017 mm.)
J	3·4260″ to 3·4263″ (87·020 to 87·027 mm.)
K	3·4264″ to 3·4267″ (87·030 to 87·037 mm.)

Oversize Pistons

Fig. 42. Showing the marking on the piston crown.

Oversize pistons are available in the following sizes:– +·010″ (·25 mm.) +·020″ (·51 mm.) +·030″ (·76 mm.).

There are no selective grades in oversize pistons as grading is necessarily purely for factory production methods.

Piston Rings

Check the piston ring gap with the ring as far down the cylinder bore as possible. Push the ring down the bore with a piston to ensure that it is square and measure the gap with a feeler gauge. The correct gaps are as follows:—

Compression rings	·015″ to ·020″ (·38 to ·51 mm.)
Oil control rings	·011″ to ·016″ (·28 to ·41 mm.)

With the rings fitted to the piston check the side clearance in the grooves which should be ·001″ to ·003″ (·025 to ·076 mm.).

One of the compression rings is hard chrome plated and this ring must be fitted to the top groove in the piston.

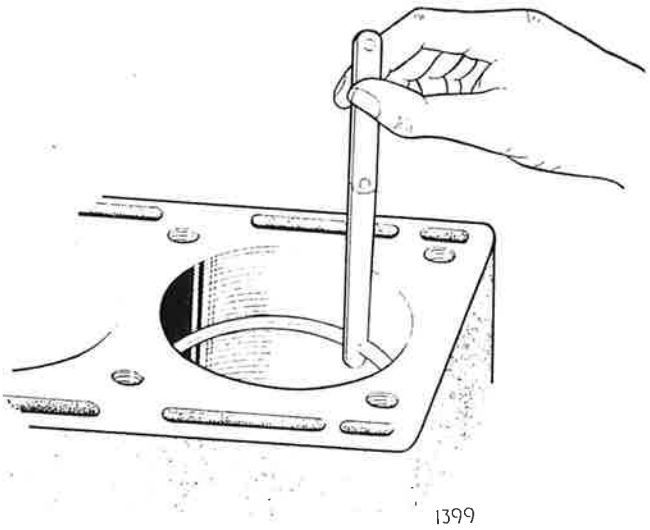


Fig. 43. Checking the piston ring gap.

Tapered Periphery Rings

All engine units are fitted with tapered periphery piston rings in at least one position and these must be fitted the correct way up.

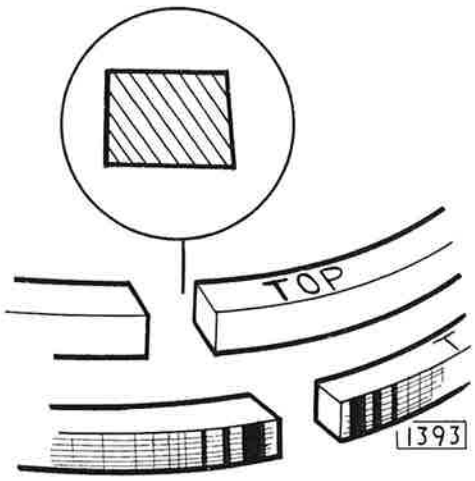


Fig. 44. Showing the identification marks on the tapered periphery compression rings.

The narrowest part of the ring must be fitted uppermost; to assist in identifying the narrowest face a letter "T" or "Top" is marked on the side of the ring to be fitted uppermost.

The oil control ring is not tapered and can be fitted either way up.

REFITTING

Pistons and connecting rods must be fitted to their respective cylinders (piston and connecting rods are stamped with their cylinder number, No. 1 being at the rear) and the same way round in the bore.

The pistons must be fitted with split on the left-hand or exhaust side of the engine. To facilitate correct fitting the piston crowns are marked "Front", see Fig. 42.

Use a piston ring clamp when entering the rings into the cylinder bore.

The cap must be fitted to the connecting rod so that the cylinder numbers stamped on each part are on the same side.

Tighten the connecting rod nuts to a torque of 37 lb.ft. (5·1 kgm.).

SPARKING PLUGS

SERVICE PROCEDURE

To maintain peak sparking plug performance, plugs should be inspected, cleaned and re-gapped at regular intervals of 2,500 miles. Under certain fuel and operating conditions, particularly extended slow speed town driving, sparking plugs may have to be serviced at shorter intervals.

Disconnect the ignition cables from all sparking plugs.

Loosen the sparking plugs about two turns anti-clockwise using the proper sized deep-socket wrench.

Blow away the dirt from around the base of each plug.

Remove the sparking plugs and place them in a suitable holder, preferably in the order they were in the engine.

ANALYSING SERVICE CONDITIONS

Examine the gaskets to see if the sparking plugs were properly installed. If the gaskets were excessively compressed, installed on dirty seats or distorted, leakage has probably occurred during service which would tend to cause overheating of the sparking plugs. Gaskets properly installed will have flat clean surfaces. Gaskets which are approximately one-half their original thickness will be satisfactory but thinner ones should be renewed.

Examine the firing ends of the sparking plugs, noting the type of the deposits and the degree of electrode erosion. The typical conditions illustrated may indicate the use of a sparking plug with an incorrect heat range or faulty engine and ignition system operation. Remember that if sufficient voltage is not delivered to the sparking plug, no type of plug can fire the mixture in the cylinder properly.

Normal Condition

Look for powdery deposits ranging from brown to greyish tan. Electrodes may be worn slightly. These are signs of a sparking plug of the correct heat range used under **normal** conditions, that is mixed periods of high speed and low speed driving. Cleaning and re-gapping of the sparking plugs is all that is required.

Normal Condition

Watch for white to yellowish powdery deposits. This usually indicates long periods of constant speed driving or a lot of slow speed city driving. These deposits have no effect on performance if the sparking

Fig. 45. Normal condition.

plugs are cleaned **thoroughly** at approximately 2,500 miles intervals. Remember to "wobble" the plug during abrasive blasting in the Champion Service Unit. Then file the sparking surfaces vigorously to expose bright clean metal.

Oil Fouling

This is usually indicated by wet, sludgy deposits traceable to excessive oil entering the combustion chamber through worn cylinders, rings and pistons, excessive clearances between intake valve guides and stems, or worn and loose bearings, etc. Hotter sparking plugs may alleviate oil fouling temporarily, but in severe cases engine overhaul is called for.

Fig. 46. Oil fouling.

Petrol Fouling

This is usually indicated by dry, fluffy black deposits which result from incomplete combustion. Too rich an air-fuel mixture, excessive use of the mixture

Fig. 47. Petrol fouling.

control or a faulty automatic choke can cause incomplete burning. In addition, a defective coil, contact breaker points, or ignition cable, can reduce the voltage supplied to the sparking plug and cause misfiring. If fouling is evident in only a few cylinders, sticking valves may be the cause. Excessive idling, slow speeds, or stop-and-go driving, can also keep the plug temperatures so low that normal combustion deposits are not burned off. In the latter case, hotter plugs may be installed.

Burned or Overheated Condition

This condition is usually identified by a white, burned or blistered insulator nose and badly eroded electrodes. Inefficient engine cooling and improper

Fig. 48. Badly burned sparking plug.

ignition timing can cause general overheating. Severe service, such as sustained high speed and heavy loads, can also produce abnormally high temperatures in the combustion chamber which necessitate the use of colder sparking plugs.

File the sparking surfaces of the electrodes by means of a point file. If necessary, open the gaps slightly and file vigorously enough to obtain bright, clean, parallel surfaces. For best results, hold the plug in a vice.

Reset the gaps using the bending fixture of the Champion Gap Tool. Do not apply pressure on the centre electrode as insulator fractures may result. Use the bending fixture to obtain parallel sparking surfaces for maximum gap life.

Visually inspect all sparking plugs for cracked or chipped insulators. Discard all plugs with insulator fractures.

Test the sparking ability of a used sparking plug on a comparator.

Clean the threads by means of wire hand or power-driven brush. If the latter type is used, wire size should not exceed ·005″ (·127 mm.) diameter. Do not wire brush the insulator nor the electrodes.

Clean gasket seats on the cylinder head before installing sparking plugs to ensure proper seating of the sparking plug gasket. Then, using a new gasket, screw in the plug by hand finger-tight.

Note: If the sparking plug cannot be seated on its gasket by hand, clean out the cylinder head threads with a clean-out tap or with another used sparking plug having three or four vertical flutes filed in its threads.
Grease the tap well to retain chippings which may fall into the combustion chamber.
Tighten the sparking plugs to a torque of 27 lb.ft. (3·73 kgm.).

STANDARD GAP SETTING

The sparking plug gap settings recommended in this Service Manual have been found to give the best overall performance under all service conditions. They are based on extensive dynamometer testing and experience on the road, and are generally a compromise between the wide gaps necessary for best idling performance and the small gaps required for the best high speed performance.

All plugs should be reset to the specified gap by bending the side electrode only, using the special tool available from the Champion Sparking Plug Company.

SPARKING PLUG INSERTS (Fig. 50)

When it becomes necessary to fit a sparking plug insert in the event of a stripped thread proceed as detailed below.

Bore out the stripped thread to ·75″ (19·05 mm.) diameter and tap $\frac{1}{2}$″ B.S.P.

Counterbore $\frac{57}{64}$″ (22·62 mm.) diameter to accommodate the larger diameter of the insert.

Fit the screwed insert ensuring that it sits firmly on the face at the bottom of the thread.

Drill and ream a $\frac{1}{8}$″ (3·17 mm.) diameter hole $\frac{3}{16}$″ (4·76 mm.) deep between the side of the insert and the cylinder head as shown. Drive in the locking pin and ensure that the pin is below the surface. To secure peen over the aluminium on the chamfered portion of the insert and also peen over the locking pin.

Fig. 49. Setting the gap with the special tool.

TAPPETS, TAPPET GUIDES AND ADJUSTING PADS

The chilled cast iron tappets are of cylindrical form and run in guides made of austenitic iron which are shrunk into the cylinder head. A steel pad for adjustment of the valve clearance is sandwiched between the underside of the tappet and top of the valve stem. The pads are available in a range of thicknesses, rising in ·001″ (·025 mm.) steps, from ·085″ to ·110″ (2·16 to 2·79 mm.) and are etched on the surface with the letter "A" to "Z", each letter indicating an increase in size of ·001″ (·025 mm.). (Page B.61).

REMOVAL OF TAPPETS AND ADJUSTING PADS

Remove the camshafts as described on page B.33. The tappets can now be withdrawn with a suction valve grinding tool.

Remove the adjusting pads. If valve clearance adjustment is not being carried out the adjusting pads must be refitted to their original positions.

OVERHAUL

Examine the tappets and tappet guides for signs of wear. The diametrical clearance between the tappet and tappet guide should be ·0008″ to ·0019″ (·02 to ·05 mm.).

Examine the adjusting pads for signs of indentation. Renew if necessary with the appropriate size when making valve clearance adjustment on re-assembly.

Tappet Guide Replacement

If it is found necessary to replace the tappet guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Remove the old tappet guide by boring out until the guide collapses. Take care not to damage the bore for the guide in the cylinder head.

(2) Carefully measure the diameter of the tappet guide bore in the cylinder head at room temperature—68°F (20°C).

(3) Grind down the 1·643″ (41·73 mm.) outside diameter of tappet guide to a diameter of ·003″ (·08 mm.) larger than the tappet guide bore dimension, that is to give an interference fit of ·003″ (·08 mm.).

(4) Also grind off the same amount from the "lead-in" at the bottom of tappet guide. The reduction in diameter from the adjacent diameter should be ·0032″ to ·0057″ (·08 to ·14 mm.).

(5) Heat the cylinder head in an oven for half an hour from cold at a temperature of 300°F (150°C).

(6) Fit the tappet guide, ensuring that the lip at top of guide beds evenly in the recess.

(7) After fitting, ream tappet guide bore to a diameter of $1\frac{3}{8}''$ $^{+\cdot0007''}_{-\cdot0000''}$ (34·925 $^{+\cdot018}_{-\cdot000}$ mm).

Note: It is essential that, when reamed, the tappet guide bore is concentric with the bore of the valve guide.

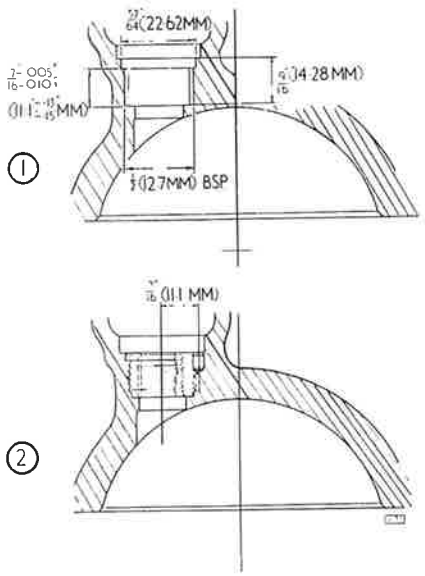


Fig. 50. Fitting dimensions for sparking plug inserts.

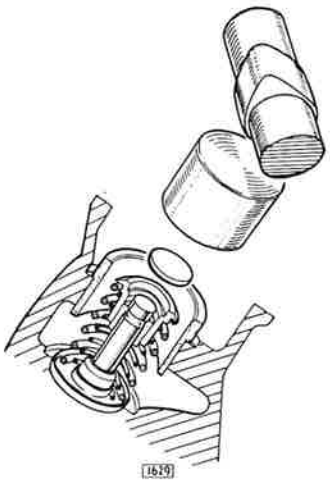


Fig. 51. Showing the tappet and adjustment pad.

THE TIMING GEAR

The camshafts are driven by Duplex endless roller chains in two stages.

The first stage or bottom timing chain drives the larger wheel of a double intermediate sprocket; the second stage or top timing chain passes round the smaller wheel of the intermediate sprocket, both camshaft sprockets, and is looped below an idler sprocket.

The idler sprocket has an eccentric shaft for top timing chain tension adjustment and the bottom chain is automatically tensioned by an hydraulic tensioner bolted to the cylinder block. Nylon or rubber vibration dampers are located at convenient points around the chains.

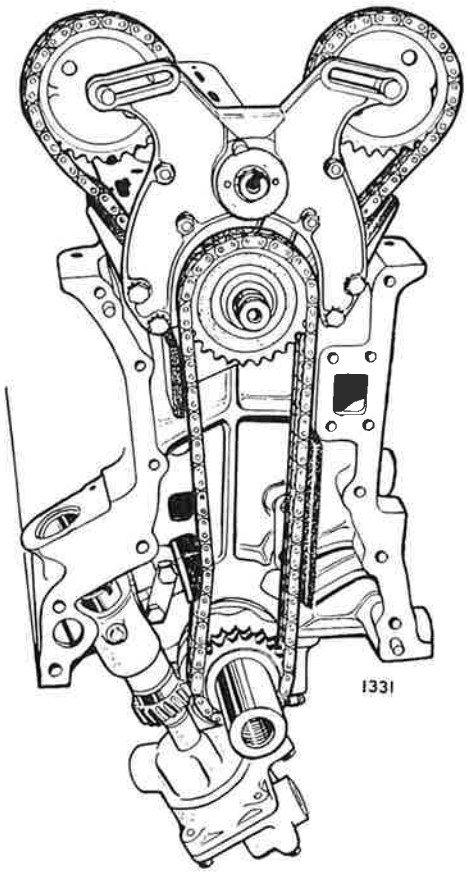


Fig. 52. The timing gear arrangement.

REMOVAL

Remove the cylinder head as described on page B.41.

Remove the radiator, cowl, header tank and cooling fan (as described in Section D "Cooling System").

Remove the damper as described on page B.35.

Withdraw the split cone.

Remove the sump as described on page B.50.

Unscrew the set bolts and nuts, and remove the water pump from the timing cover.

Note the gasket between the pump and the timing cover.

Remove the front cover as described on page B.22.

Remove the bottom timing chain tensioner as described on page B.59.

Unscrew the four setscrews securing the front mounting bracket to the cylinder block.

Remove the two screwdriver slotted setscrews securing the rear mounting bracket; these setscrews secure the intermediate damper bracket.

The timing gear assembly can now be removed.

DISMANTLING

Remove the nut and serrated washer from the front end of the idler shaft, and withdraw the plunger and spring.

Remove the four nuts securing the front mounting bracket to the rear bracket. Withdraw the front bracket from the studs.

Remove the bottom timing chain from the large intermediate sprocket.

To remove the intermediate sprockets, remove the circlip from the end of the shaft in the mounting bracket. Press the shaft out of the bracket, and withdraw the sprockets from the shaft.

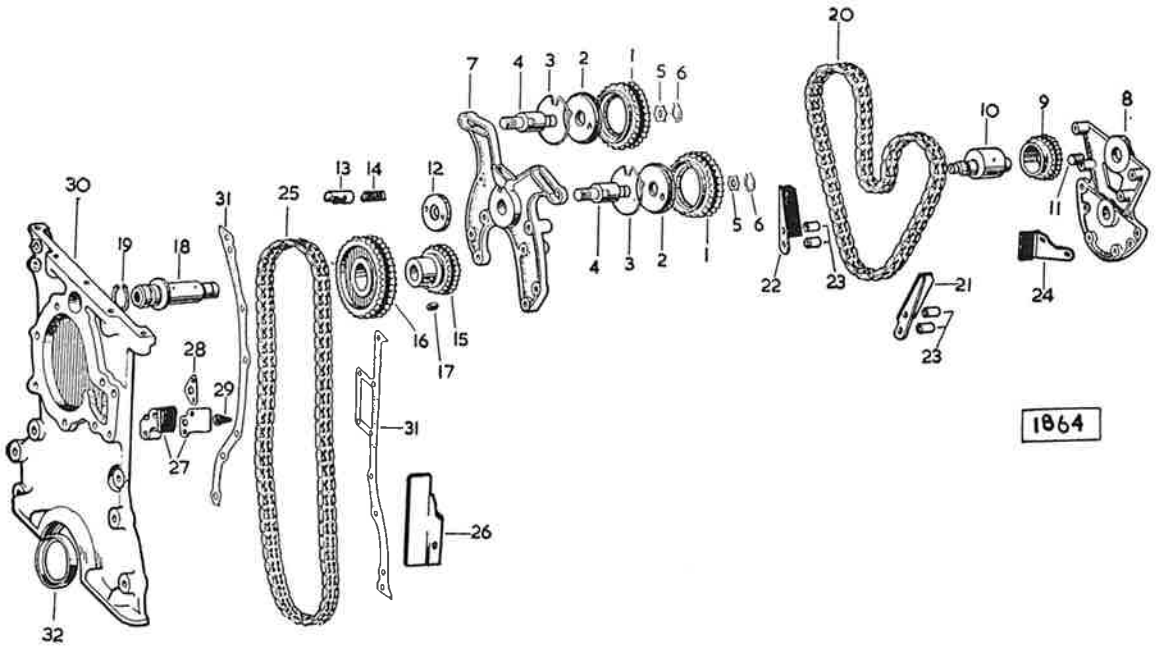
To separate the two intermediate sprockets, press the boss of the small sprocket from the bore of the large sprocket, noting that they are keyed together. (On later models the intermediate sprocket is in one piece).

OVERHAUL

If the chain shows signs of stretching or wear new ones should be fitted. Replace any sprockets and dampers that show signs of wear.

ASSEMBLING

Fit the eccentric shaft to the hole in front mounting bracket. Insert the spring and locking plunger for the serrated plate to the hole in the front mounting bracket.



1. Camshaft sprocket
2. Adjusting plate
3. Circlip
4. Guide pin
5. Star washer
6. Circlip
7. Timing gear front mounting bracket
8. Timing gear rear mounting bracket
9. Idler sprocket
10. Eccentric shaft
11. Plug
12. Adjustment plate
13. Plunger pin
14. Spring
15. Intermediate sprocket of top timing chain
16. Intermediate sprocket of lower timing chain
17. Key
18. Shaft
19. Circlip
20. Top timing chain
21. Damper for top timing chain (left hand)
22. Damper for top timing chain (right hand)
23. Distance piece
24. Intermediate damper
25. Bottom timing chain
26. Vibration damper
27. Hydraulic chain tensioner
28. Shim
29. Filter gauze
30. Front timing cover
31. Gasket
32. Oil seal

Fig. 53. Exploded view of the timing gear.

Fit the serrated plate and secure with the shakeproof washer and nut. Fit the idler sprocket (21 teeth) to the eccentric shaft.

Fit the two intermediate sprockets (20 and 28 teeth) to their shaft with the larger sprocket forward and press the shaft through lower central hole in rear mounting bracket. Secure with the circlip at the rear of bracket.

Fit the top timing chain (longer chain) to the small intermediate sprocket and the bottom timing chain (shorter chain) to the large intermediate sprocket.

Loop the upper timing chain under the idler sprocket and offer up the front mounting bracket to the rear mounting bracket with the two chain dampers interposed between the brackets.

Fit the intermediate damper to the bottom of the rear mounting bracket with two screwdriver slotted setscrews and shakeproof washer.

Pass the four securing bolts through the holes in the brackets, chain dampers and spacers noting that shakeproof washers are fitted under the bolt heads. Secure the two mounting brackets together with four stud nuts and shakeproof washers.

REFITTING

Refitting the remainder of the assembly is the reverse of the removal procedure.

When refitting the timing chain tensioner refer to page B.59.

THE BOTTOM CHAIN TENSIONER

The bottom timing chain tensioner is of hydraulic type and consists of an oil resistant rubber slipper mounted on a plunger (A, Fig. 54) which bears on the outside of the chain. The light spring (C) cased by the restraint cylinder (B) and the plunger, in combination with oil pressure holds the slipper head against the chain keeping it in correct tension.

Return movement of the slipper head is prevented by the limit peg at the bottom end of the plunger bore engaging the nearest tooth in the helical slot of the restraint cylinder. The oil is introduced into the adjuster body (D) via a small drilling in the locating spigot and passing through a hole in the slipper head lubricates the chain. The backing plate (E) provides a suitable face along which the slipper head can work.

REMOVAL

Proceed as described under "Timing Gear—Removal" on page B.57 until the chain tensioner is accessible.

Remove the bottom plug which provides access to the hexagonal hole in the end of the restraint cylinder. Insert an Allen key (·125"A/F) into this and turn the key in a *clockwise* direction until the slipper head remains in the retracted position. Remove the securing bolts and detach the adjuster. A conical filter is fitted in the oil feed hole in the cylinder block and this should be removed and cleaned in petrol.

REFITTING

Fit the conical filter to the oil feed hole in the cylinder block.

Fit shims as necessary, between the backing plate and cylinder block so that the timing chain runs centrally along the rubber slipper.

Fit the tab washer and two securing bolts. Tighten the bolts and tap the tab washers against the bolt heads.

It is important that no attempt is made to release the locking mechanism until the adjuster has been finally mounted in the engine WITH THE TIMING CHAIN IN POSITION.

Remove the hexagon head plug and tab washer from the end of the body. Insert the Allen key into

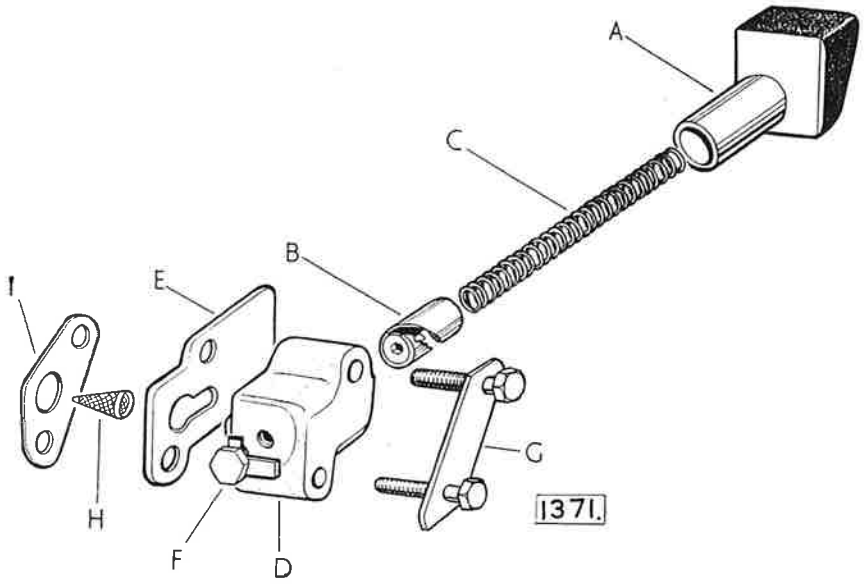


Fig. 54. Exploded view of the bottom timing chain tensioner.

the hole until it registers in the end of the restraint cylinder. Turn the key clockwise until the tensioner head moves forward under spring pressure against the chain. Do not attempt to turn the key anti-clockwise, nor force the tensioner head into the chain by external pressure.

Refit the plug and secure with the tab washer.

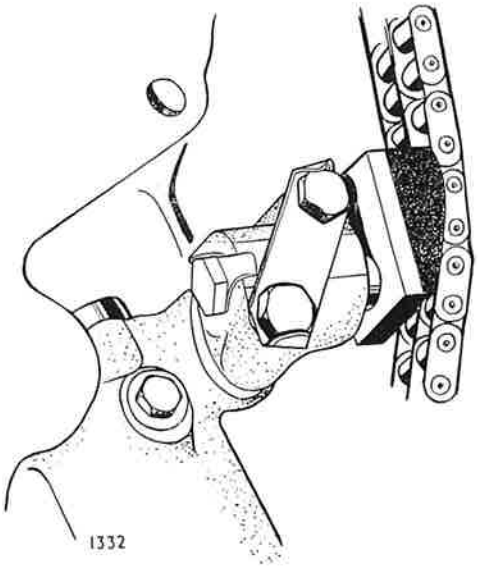


Fig. 55. Showing the bottom timing chain tensioner in position.

THE VALVES AND SPRINGS

The inlet valves are of silicon chrome steel and the exhaust valves are of austenitic steel. Double coil valve springs are fitted and are retained by a valve collar with split cotters.

Warning: As the valves in the fully open position protrude below the cylinder head joint face, the cylinder head must not be placed joint face downwards directly on a flat surface; support the cylinder head on wooden blocks, one at each end.

REMOVAL

Removal the cylinder head as described on page B.41

Remove Valves

With the cylinder head on the bench remove the inlet manifold, and the revolution counter generator.

Remove the four bearing caps from each camshaft and lift out the camshafts (note mating marks on each bearing cap).

Remove the twelve tappets and adjusting pads situated between tappets and valve stems. Lay out the tappets and pads in order, to ensure that they can be replaced in their original guides.

Obtain a block of wood the approximate size of the combustion chambers and place this under the valve heads in No. 1 cylinder combustion chamber. Press down the valve collars and extract the split cotters. Remove the collars, valve springs and spring seats. Repeat for the remaining five cylinders. Valves are numbered and must be replaced in the original locations, No. 1 cylinder being at the rear, that is, the flywheel end.

OVERHAUL

Valves

Examine the valves for pitting, burning or distortion and reface or renew the valves as necessary. Also reface the valve seats in the cylinder head and grind the valves to their seats using a suction valve tool. When refacing the valves or seat inserts do not remove more metal than is necessary to clean up the facings.

The valve seat angles are as follows:—inlet and exhaust, 45°.

Renew valves where the stem wear exceeds ·003″ (·08 mm.). The clearance of the valve stem in the guide when new is ·001″ to ·004″ (·025 to ·10 mm.).

Valve Springs

Test the valve springs for pressure, either by comparison with the figures given in the "Valve Spring

Data" or by comparison with a new valve spring.

To test against a new valve spring, insert both valve springs to end between the jaws of a vice or under a press with a flat metal plate interposed between the two springs. Apply a load to compress the springs partly and measure their comparative lengths.

When fitting valve springs to the cylinder head compress the springs using Churchill tool No. J.6118.

VALVE CLEARANCE ADJUSTMENT

When checking the valve clearances, the camshafts must be fitted one at a time as if one camshaft is rotated when the other camshaft is in position, fouling is likely to take place between the inlet and exhaust valves. Obtain and record all valve clearances by using a feeler gauge between the back of each cam and the appropriate valve tappet.

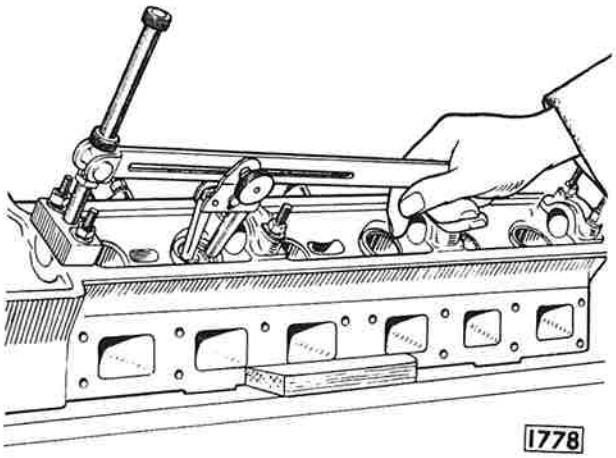


Fig. 56. Fitting the valve springs utilizing the valve spring compressing tool Churchill tool No. J.6118.

Correct valve clearances are:—

Normal Touring Use		
Inlet	.. ..	·004″ (·10 mm.)
Exhaust	.. ..	·006″ (·15 mm.)
Racing		
Inlet	.. ..	·006″ (·15 mm.)
Exhaust	.. ..	·010″ (·25 mm)

Adjusting pads are available rising in ·001″ (·03 mm.) sizes from ·085″ to ·110″ (2·16 to 2·79 mm.) and are etched on the surface with the letter 'A' to 'Z', each letter indicating an increase in size of ·001″ (·03 mm.). Should any valve clearance require correction, remove the camshaft, tappet and adjusting pad. Observe the letter etched on the adjusting pad if visible. If the letter is not visible measure the pad with a micrometer and should the recorded clearance for this valve have shown say ·002″ (·05 mm.) excessive clearance select a new adjusting pad bearing a letter two lower than the original pad.

As an example, assume that No. 1 inlet valve clearance is tested and recorded as ·007″ (·18 mm.). On removal of the adjusting pad, if this is etched with the letter 'D' then substitution with a pad bearing the letter 'G' will correct the clearance for No. 1 inlet valve.

Valve Adjusting Pads

	ins.	mm.
A	·085	2·16
B	·086	2·18
C	·087	2·21
D	·088	2·23
E	·089	2·26
F	·090	2·29
G	·091	2·31
H	·092	2·34
I	·093	2·36
J	·094	2·39
K	·095	2·41
L	·096	2·44
M	·097	2·46
N	·098	2·49
O	·099	2·51
P	·100	2·54
Q	·101	2·56
R	·102	2·59
S	·103	2·62
T	·104	2·64
U	·105	2·67
V	·106	2·69
W	·107	2·72
X	·108	2·74
Y	·109	2·77
Z	·110	2·79

When fitting the camshafts prior to fitting the cylinder head to the engine it is most important that the keyway in the front bearing flange of each camshaft is perpendicular (at 90°) to the adjacent camshaft cover face before tightening down the camshaft bearing cap nuts. Tighten the camshaft bearing cap nuts to a torque of 15 lb.ft. (2·0 kgm.).

REFITTING

Before attempting to refit the cylinder head refer to the instructions given on page B.42.

THE VALVE GUIDES

The valve guides are of cast iron and are chamfered at the upper ends. The outside diameter of the guide is reduced at the upper end to provide a "lead-in" when fitting the guide to the cylinder head. The inlet and exhaust guides are of different lengths, the inlet being the shorter of the two.

REPLACEMENT

Examine the valve guides for evidence of wear in the bore. The clearance between the valve stem and the guide when new is ·001″ to ·004″ (·025 to ·10 mm.).

If it is found necessary to replace worn valve guides they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Press out, or drive out with a piloted drift, the old valve guide from the top of the cylinder head.

(2) Ream the valve guide bore in the cylinder head to a diameter of

$$\cdot 505'' \begin{matrix} +\cdot 0005'' \\ -\cdot 0002'' \end{matrix} \ (12 \cdot 83 \text{ mm.} \begin{matrix} +\cdot 012 \text{ mm.} \\ -\cdot 005 \text{ mm.} \end{matrix})$$

(3) Heat the cylinder head by immersing in boiling water for 30 minutes.

(4) Coat the valve guide with graphite grease and press in, or drive in with a piloted drift, from the combustion chamber end. The correct fitted position for both inlet and exhaust guides is with the top of the guide (chamfered end) $\frac{5}{16}''$ (8 mm.) above the spot facing for the valve spring seat. (See Fig. 57).

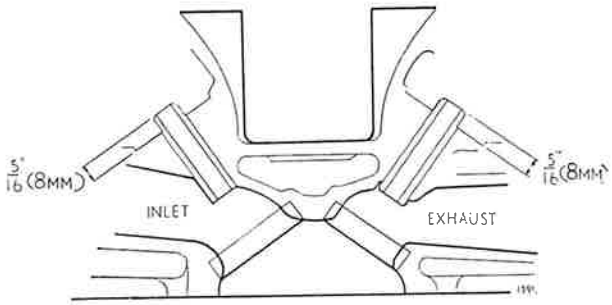


Fig. 57. Showing the fitted position of the valve guide.

THE VALVE SEAT INSERTS

The valve seat inserts are centrifugally cast iron and are shrunk into the cylinder head.

REPLACEMENT

If it is found necessary to replace the valve seat inserts they must be fitted in accordance with the following instructions and only genuine factory replacement parts used.

(1) Remove the old valve seat insert by boring out until the insert collapses. Take care not to damage the recess for insert in the cylinder head.

(2) Carefully measure diameter of insert recess in cylinder head at room temperature 68°F. (20°C.).

(3) Grind down outside of insert to a diameter of ·003″ (·08 mm.) larger than recess dimension, that is, to give an interference fit of ·003″ (·08 mm.).

(4) Heat the cylinder head in an oven for one hour from cold at a temperature of 300°F.(150° C.).

(5) Fit insert, ensuring that it beds evenly in its recess.

(6) After the valve seat insert has been fitted the following instructions should be carried out to ensure that the valve clearance can be obtained within the range of the adjusting pads, that is, ·085″ to ·110″ (2·16 to 2·79 mm.).

(a) Assemble the camshafts to the cylinder head. Fit the appropriate valve to the insert in question and, with the valve seat faces touching, check the distance between the top of the valve stem and the **back** of the cam. This should be ·320″ (8·13 mm.) **plus** the appropriate valve clearance. (The figure of ·320″ (8·13 mm.) includes an allowance for an adjusting pad thickness of ·095″ (2·41 mm.) to ·097″ (2·46 mm.) which will, if necessary, permit the fitting of thicker or thinner adjusting pads when making the final valve clearance adjustment).

(b) If the distance is greater than the figure of ·320″ (8·13 mm.), plus the appropriate valve clearance, grind the valve seat of the insert with suitable valve grinding equipment until the correct distance is obtained.

Example: Assume that the valve insert in question is an exhaust and the distance between the top of the valve stem and the back of the cam is found to be ·344″ (8·74 mm.).

Adding the exhaust valve clearance of ·006″ (·15mm.) to ·320″ (8·13 mm.) equals ·326″ (8·28 mm.). In this case the valve seat of the insert will have to be ground down to reduce the distance between the top of valve stem and the back of the cam by ·018″ (·46 mm.) that is, ·344″ minus ·326″ (8·74 minus 8·28 mm.).

(c) After assembling the cylinder head, check and adjust the valve clearances in the normal manner.

VALVE TIMING

Turn the engine so that No. 6 (front) piston is exactly in the T.D.C. position on compression stroke (firing position) that is, with the distributor rotor arm opposite No. 6 cylinder segment. (See Fig. 19).

See Figs. 32 or 61 for location of T.D.C. marks.

It is important to tension the top timing chain before attempting to check or set the valve timing. Proceed as follows:—

Through the breather aperture in the front of the cylinder head slacken the locknut securing the serrated plate (Fig. 58).

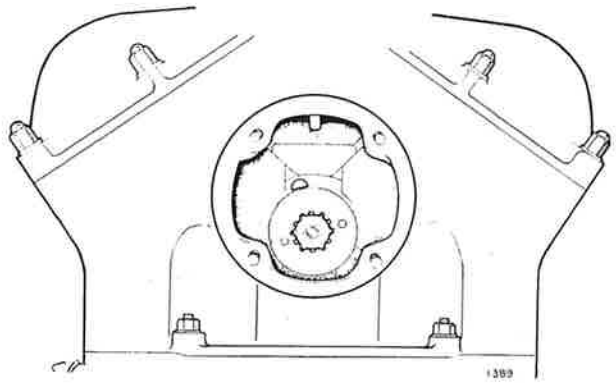


Fig. 58. Showing the serrated plate for adjustment of the top timing chain tension.

Tension the chain by pressing locking plunger inwards and rotating serrated plate by the two holes in an anti-clockwise direction. Turn the engine each way slightly and recheck the chain tension. When correctly tensioned there should be slight flexibility on both outer sides below the camshaft sprockets, that is, the chain must not be dead tight. Release the locking plunger and securely tighten the locknut.

Remove the locking wire from the setscrews securing the camshaft sprockets. Note the positions of the **inaccessible** setscrews and rotate the engine until they can be removed. Remove the setscrew from each sprocket and turn the engine back to the T.D.C. position with the No. 6 firing and remove the remaining screws. Tap the camshaft sprockets off the flanges of the camshafts.

Accurately position the camshafts with the valve timing gauge, and check that the T.D.C. marks are in exact alignment.

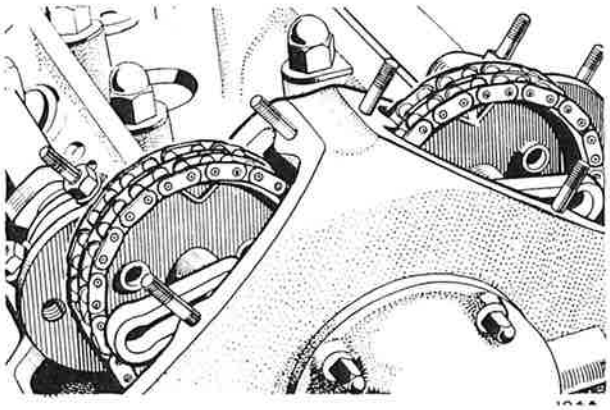


Fig. 59. Showing the camshaft sprockets disconnected from the camshafts.

Withdraw the circlips retaining the adjusting plates to the camshaft sprockets and press the adjusting plates forward until the serrations disengage. Replace the sprockets on the flanges of camshafts and align the two holes in the adjuster plate with the two tapped holes in each camshaft flange. Engage the serrations of the adjuster plates with the serrations in the sprockets.

Note: It is most important that the holes are in exact alignment, otherwise when the set-screws are fitted, the camshafts will be moved out of position. If difficulty is experienced in aligning the holes exactly the adjuster plates should be turned through 180°, which due to the construction of the plate will facilitate alignment.

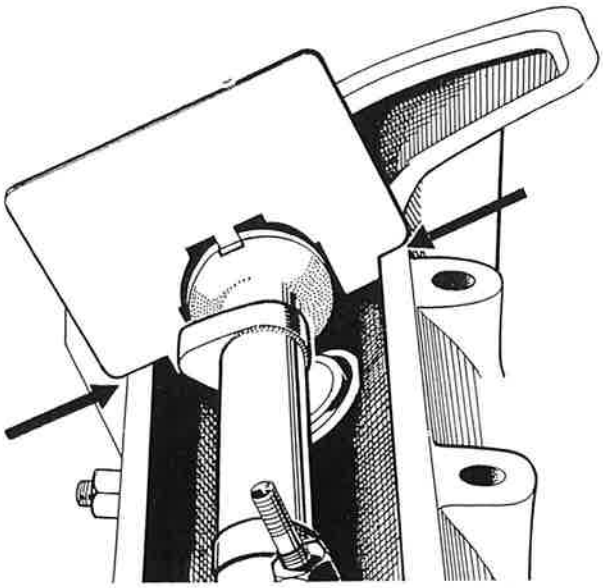


Fig. 60. The valve timing gauge in position. Ensure that the gauge is seated at the points indicated by the arrows.

Fit the circlips to the sprockets and one setscrew to the accessible holes in each adjuster plate. Turn the engine until the other two holes are accessible and fit the two remaining setscrews.

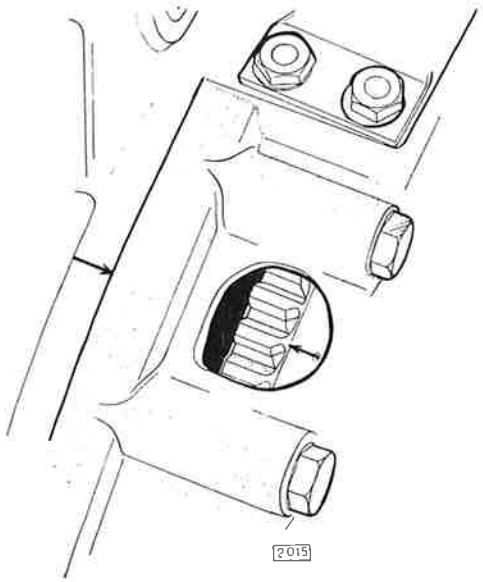


Fig. 61. Showing the location of the Top Dead Centre marks on the left hand side of the combined engine and transmission unit.

Finally, recheck the timing chain tension and valve timing in this order. Secure the four setscrews for camshaft sprockets with new locking wire.

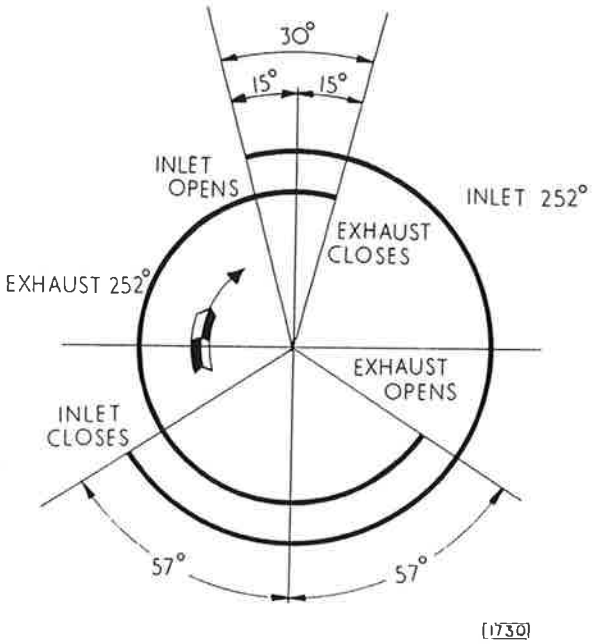


Fig. 62. The valve timing diagram.

EV öffnet 15° v OT
schließt 57° n UT

AV öffnet 57° v UT
schließt 15° n OT

ENGINE MOUNTINGS

The engine is supported at the front on two rubber mountings which are attached to brackets on the front subframe. The rear is supported on two rubber mountings between the gearbox rear cover and a mounting plate attached to the body underframe.

FRONT ENGINE MOUNTINGS

Removal

Either place a sling around the front of the engine or attach a lifting plate to the cylinder head, as described in "Engine Removal" Page B.19. Unscrew the large set bolt and remove the spring washer, plain washer and bolt securing the front engine mounting bracket to the mounting rubber. Repeat for the other side.

Raise the engine so that the front mounting brackets are just clear of the mounting rubbers.

Remove the two bolts and self-locking nuts securing the front engine mounting to the support bracket on the front subframe. Repeat for the other side.

Refitting

Refitting is the reverse of the removal procedure.

REAR ENGINE MOUNTINGS

Removal

Remove the eight nuts and spring washers at the exhaust manifold flanges and the bolts from the five body mountings and withdraw the exhaust system from below.

Remove the small asbestos heat shield attached to the rear engine mounting plate.

Support the engine either by slinging or on a lifting plate as described in "Engine Removal" page B.19.

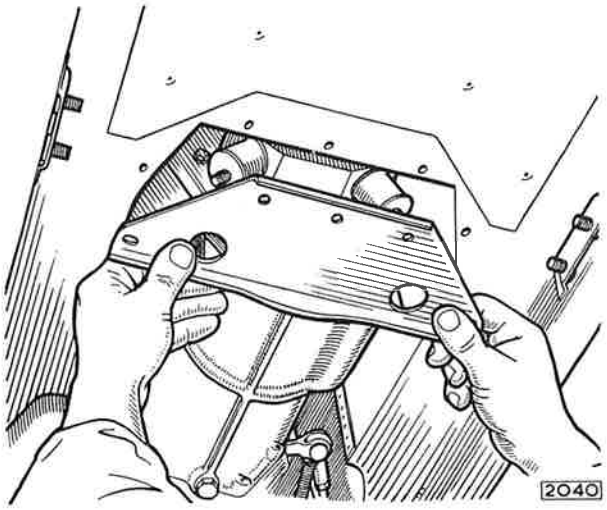


Fig. 63. The engine rear mounting plate.

Remove the self locking nuts securing the lower ends of the rear engine mountings to the mounting plate through the holes in the plate.

Remove the five bolts securing the mounting plate to the body and withdraw the plate.

Remove the propeller shaft tunnel cover and the gearbox cowl as described in "Engine Removal" page B.19.

Remove the self locking nuts securing the top ends of the engine mountings to the gearbox rear cover.

Withdraw the rear engine mountings from below.

Refitting

Refitting is the reverse of the removal procedure. New exhaust manifold sealing rings should be fitted.

AIR CLEANER

The air cleaner is of the paper element type mounted on the right hand side of the engine compartment and connected to the carburetters by means of an elbow trumpet plate. Servicing instructions are given in "Routine Maintenance" on page B.17.

REMOVAL

Unscrew the two butterfly nuts at the carburetter trumpet plate. Remove the air cleaner elbow. Unfasten the three spring clips and withdraw the air cleaner element assembly. Remove the serrated nut from the base of the assembly and withdraw the paper element.

Remove the nut and shakeproof washer at the base of the air cleaner canister. Remove the two setscrews at the side of the canister and withdraw the canister.

REFITTING

Refitting is the reverse of the removal procedure.

THE ENGINE STABILISER

The engine stabiliser is situated at the rear of the engine and consists of a rubber/steel mounting attached to the body which is connected to brackets on the clutch housing via a rubber bushed link pin. The link pin is threaded at its upper end and is connected to the rubber mounting by means of flanged washers and a self-locking nut.

ADJUSTMENT

It is MOST IMPORTANT that the stabiliser is assembled in the following manner, as failure to observe this procedure may cause engine vibration and/or fouling of the gearbox in its cowl, due to the engine having been pulled up on its mountings.

(a) Screw the lower flanged washer (D, Fig. 63) up the stabiliser pin until the flange contacts the bottom of the stabiliser rubber mounting (C). The washer is slotted on its upper face and can be screwed up the pin by engaging a thin bladed screwdriver in the slot through the centre hole of the rubber mounting.

(b) Fit the upper flanged washer (B) and tighten down with the self-locking nut (A).

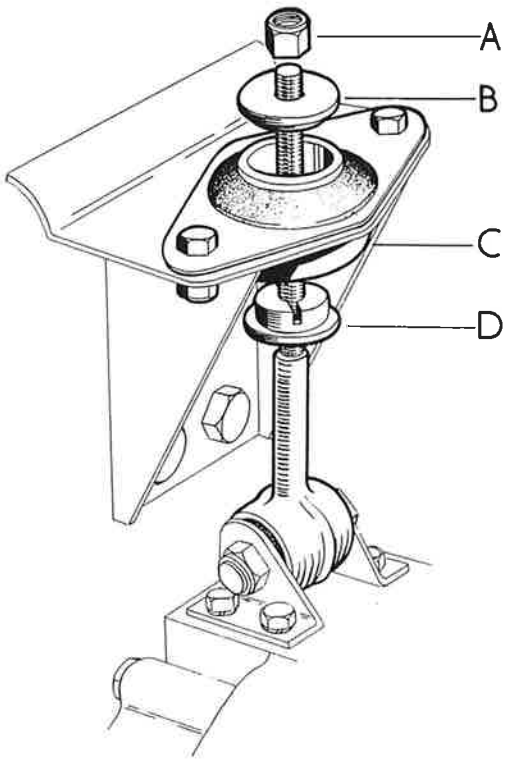


Fig. 64. The engine stabiliser.

TORSION BAR REACTION TIE PLATE

REMOVAL

The following instructions should be carried out either on a ramp or over a pit.

Remove the eight nuts and spring washers at the exhaust manifold flanges, remove the bolts from the five body mountings and withdraw the exhaust system from below discarding the manifold sealing rings.

Jack up the front of the car using a block of hard wood 16″ × 1⅛″ × 1″ (406·4 × 28·6 × 25·4 mm.) under the subframe lower cross tube as shown in (Section J "Front Suspension") until the front wheels are clear of the ground. Do NOT jack up the car unless the block of wood is in place.

Remove the lower bolt and self locking nut from the torsion bar reaction bracket and drive the locating bar (see Fig. 65) through the bracket from the front in

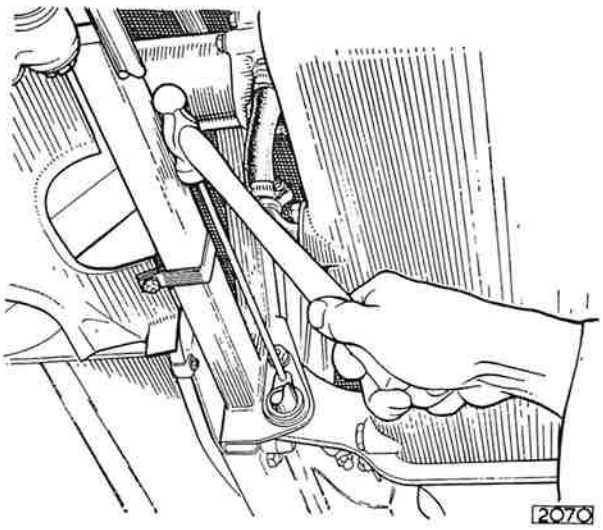


Fig. 65. Driving in the locating bars. (The torsion bar has been cut away for illustrative purposes).

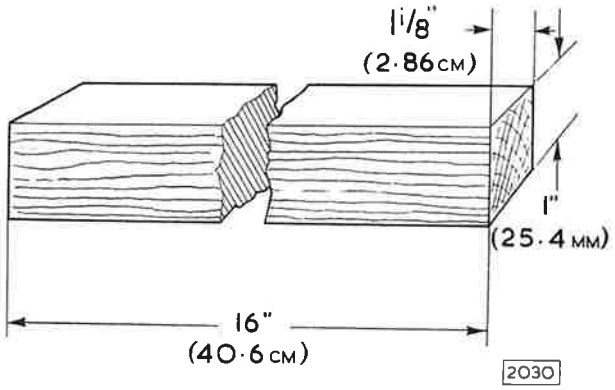


Fig. 66. The jacking block dimensions.

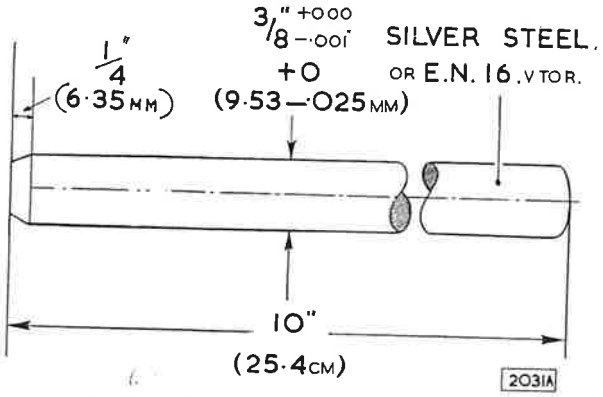


Fig. 67. The tie plate locating bar dimensions.

place of the bolt so that approximately $\frac{1}{4}$" (6·35 mm.) protrudes.

Repeat for the lower bolt on the other side and drive the second locating bar into its place.

Remove the self locking nuts from both top bolts and tap the bolts back until they are flush with the tie plate.

Remove the bolt and self locking nuts securing the tie plate to the body under frame on each side.

Withdraw the tie plate over the bolts and locating bars and remove from below ensuring that the locating bars do not lose their position.

REFITTING

Refitting is the reverse of the removal procedure, new exhaust manifold sealing rings should be fitted.

Note: If the locating bars are accidently displaced, and the torsion bar setting is lost, the torsion height will have to be reset as described in Section J "Front Suspension".

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